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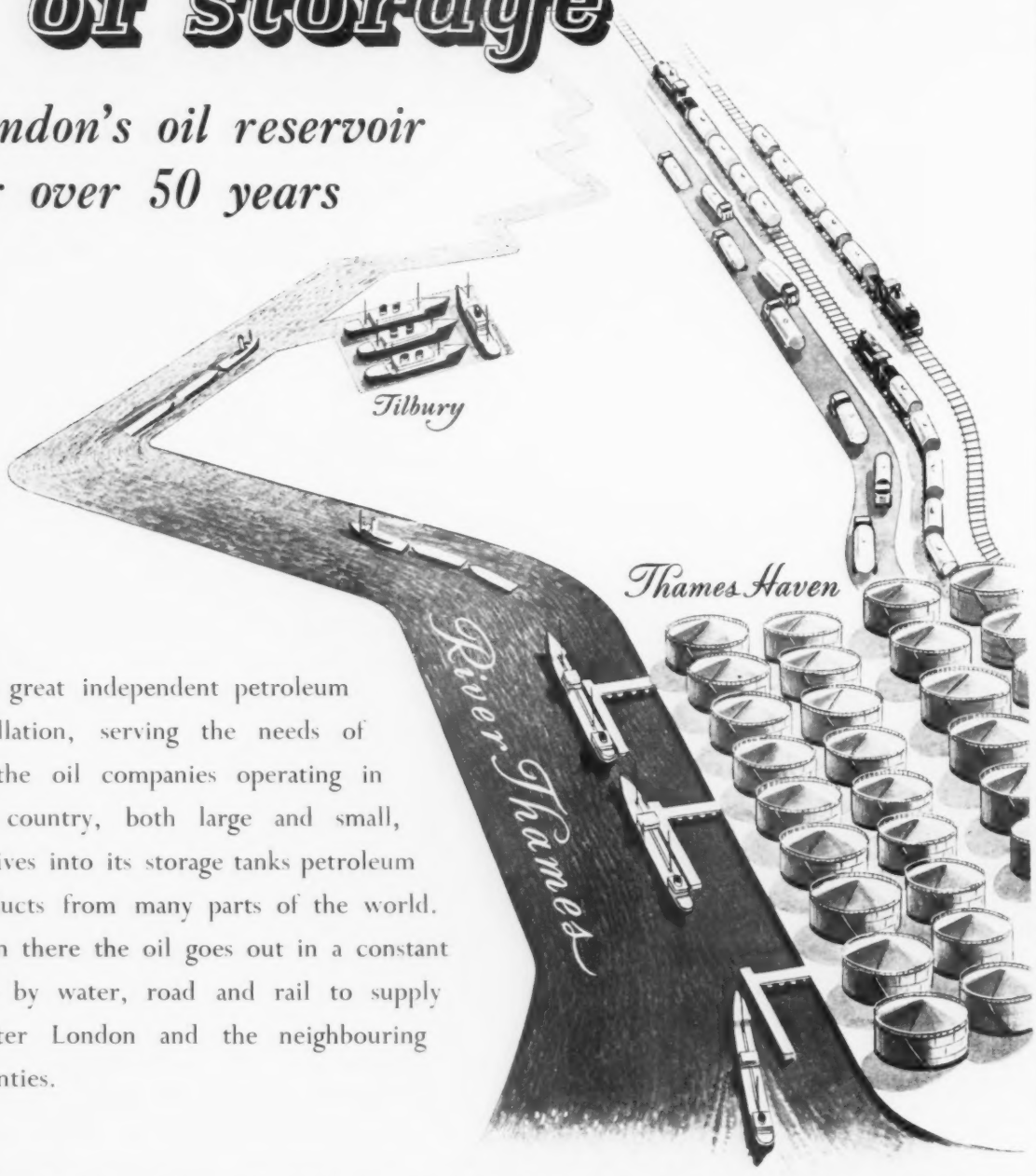

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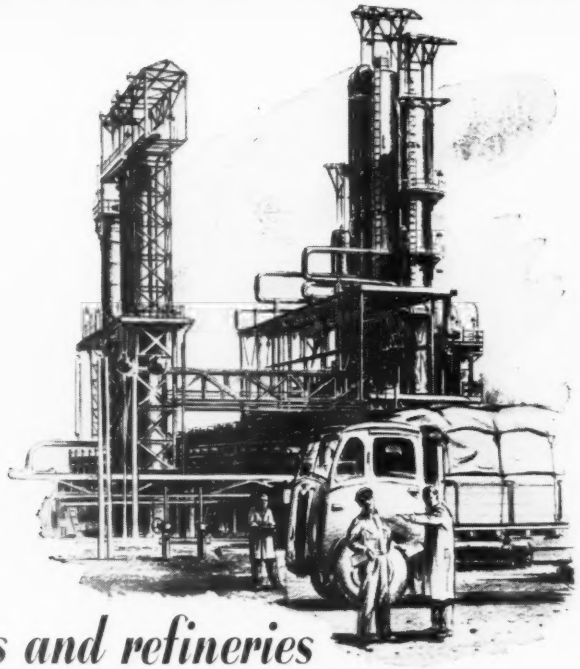

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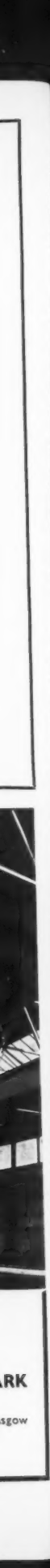

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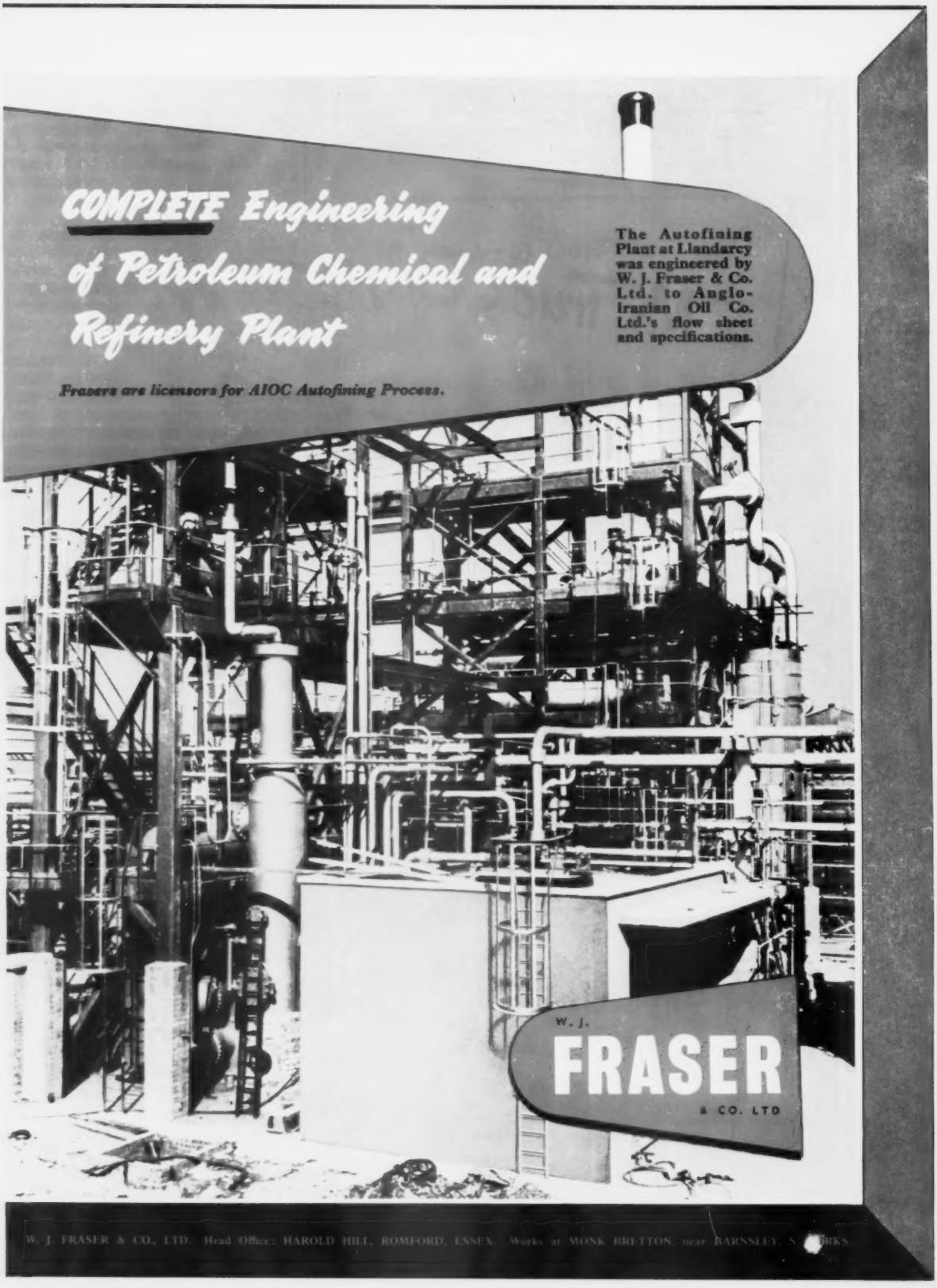
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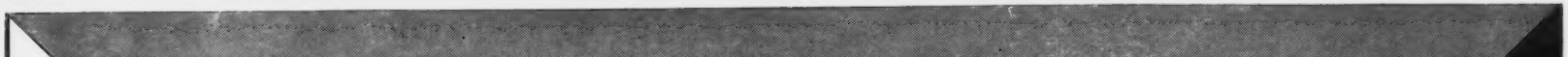


Petroleum Geology and Developments in 1951-52

By **A. E. GUNTHER** (*Fellow*)

This article was prepared for the 1952 *Review of Petroleum Technology. When the decision was taken to issue that publication at intervals of more than one year it was considered that the general review on oilfield geology and developments should be placed on record for the information contained and the views expressed therein*

Introduction

This review, like its predecessors, covers two years: 1951 and as much of 1952 as it has been possible to secure. Looking back at the progress of the discovery and development of crude oil since the war, it is beginning to be possible to see events in perspective, of which the principal are:—

First, the great increase in world demand for oil.
Second, the change in 1947 of the position of the U.S. in no longer being able to find enough oil to supply its own needs, let alone those of others.
Third, the growth of nationalism, seen in the Persian defection in 1951, and its effect on world supplies.
Fourth, technical advances which are bringing the industry into the new age.

The Reviews of 1946-48 were concerned mainly with the industry's progress towards recovery from a war just concluded. The Review of 1949-50 found recovery in terms of the industry's physical ability to meet the world's needs virtually complete. The fall in production in 1949 was a symptom of this. But in mid-1950 another war began in Korea. The history of the years 1951 and 1952 is therefore set against a background of re-armament accelerated in the first year, slowing down in the second.

In 1951 and 1952 crude oil production, supported by the economics of armaments, continued to rise, by a record of 12·9 per cent in the first year, and by 5·2 per cent in the second. The period also witnessed a crisis whose implications, as they extend into 1953, cannot as yet be gauged, namely the Persian defection. This crisis has had repercussions as great in the Middle East as in the intensity of exploration and developments in other parts of the world, and it is with these that this chapter is mainly concerned. Except in so far as political events effect physical progress, this chapter is hardly the place for politics. But the Persian defection, as a virulent form of nationalism, has profound significance. On the other hand the Grand Jury investigation into the internal activities of various United States oil companies threatened the move of many tons of filing cabinets to Washington, but it has not affected the flow of crude oil anywhere yet.

On the technical side there have, nevertheless, been certain developments which may come to mark this middle-century period in the development of the crude oil industry, and this introduction may well close with their mention:—

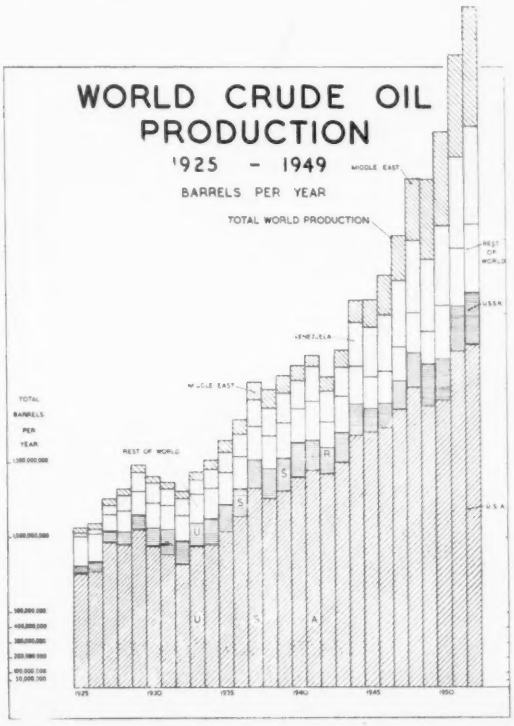
1. The technical development of geophysics, allied to geology, has enabled the conception of the continental sedimentary basin (the "oil basin") to be accepted as the unit of exploration.
2. The first exploration and development of the marine areas of the Continental Shelf, and so the engineering of marine drilling, belongs to this period.
3. The enormous demand for crude oil in the United States is bringing those concerned with exploration to think of the world's reserves as much in terms of oil shales and of tar sands as of natural crude oil.
4. The laying of "Big Inch" pipelines outside the United States is a development that has also come to mark this period.

Expansion and Crisis in 1951

In 1950, for the first time in its history, the industry had been called upon to produce 500 million tons of crude oil, at the rate equivalent to one cubic kilometre every two years. Production in 1951 was 609 mil tons; 70 mil tons or 12·9 per cent greater than 1950. Much of this increase was due to the requirements of defence in the west resulting from the outbreak of war in Korea in July 1950, and the stimulus thereby given to industrial activity. Production increased in all the world's main producing areas: in North America by 40 mil tons; in the Caribbean by 11 mil tons and in the Middle East, despite a loss from Persia of 16 mil tons, by 10 mil tons.

The effect of the Persian defection was to raise production from Saudi Arabia and from Kuwait to levels higher than Persia had ever attained. Not only were two new oilfields discovered; in Kuwait—Magwa and in Saudi Arabia—Ain Dar, but existing fields were produced to the maximum of available transport including the newly-completed Tapline which carried 15 mil tons its first full year.

The other outstanding events in the world scene were the continuing discoveries in Canada and the completion of the pipeline from Edmonton to Lake Superior; the rise of Venezuela to over 90 mil tons a year; the first flow of oil from Zubair (Iraq), estimated to reach 8 mil tons in 1955; the recovery of Indonesia to pre-war level of 8 mil tons; the discovery in Mexico of new oil and gas fields; and the expansion of production in Russia.



Persian Defection

The critical part which Persia played in relation to the world supply of oil in 1951 was seen in the first part of the year when world oil supplies were more or less in balance with demand. As the year advanced, political difficulties in Persia threatened, but the magnitude of the crisis could hardly be foreseen. In June 1951 Persian oil ceased to flow into the world markets. This meant a loss to the world industry of 5 per cent of its total oil supplies; to the Eastern Hemisphere of no less than 25 per cent. To avert a crisis, concerted and immediate action by the industry was necessary. With the approval of their governments, British and American oil committees set up machinery to ensure, through co-operative measures, that essential supplies throughout the world would not be interrupted.

The deficit was in the order not only of 150,000 barrels daily (7,500,000 tons per annum) of crude, but of over 500,000 barrels daily (25,000,000 tons p.a.) of products from the Abadan Refinery. These were replaced quantitatively, the crude by the intensive development of oilfields in many quarters of the world, particularly on the Persian Gulf, the products by the operation of refineries in excess of normal capacity and by considerable alteration in the world supply pattern. It says something for the resilience of an international industry that it not only succeeded in meeting the demands of the Persian crisis, some 16 mil tons, but was able to meet a demand greater by 13 per cent than that of the previous year, in other words a total increase of some 70 mil tons.

Consolidation in 1952

There may be an element of truth in the suggestion that the crisis of 1951 had brought the industry to stretch production beyond safe working, an effort that could not be repeated judiciously and did not have to be. 1952 was a year of consolidation. Owing largely to the slackening of the needs of the western defence industries, increase of production was smaller at 5·2 per cent over 1951. But there was no lessening in exploration activity, or in the proving of more reserves, and no let up or very little of oilfield development. The adjustments necessary in the Middle East owing to the Persian defection needed to be consolidated especially in terms of the facilities for maintaining and even raising production above 1951 levels. By the end of the year this had been accomplished.

In 1952 crude oil production reached 640 mil metric tons. Nine-tenths came from three areas, the United States, Middle East, and Caribbean. Though the United States was importing some Middle East crude, and the Eastern Hemisphere some crude and products from the Western Hemisphere, production and consumption in both was more or less in balance. Western Europe has come to rely largely on the Middle East. American dependence on Venezuela for the balance of its supplies, and to a lesser extent on the Middle East, may come to be reduced by the new developments in Canada and in Mexico. Since 1946 the United States share of world production has fallen from 60 to 50 per cent; Venezuelan production has risen by two-thirds. Oil developments in the rest of South America continue to be hampered by legal restrictions on enterprise. Whether the recent modifications in the law will attract capital to Colombia and to Peru remains to be seen, but the overall atmosphere is not favourable yet.

Since 1946, despite the loss of Persia's 32 mil tons, Middle East production has trebled. The oil goes mainly to Western Europe, some 12 per cent only to the Far East. The new discoveries in Saudi Arabia, the remarkable development of Kuwait, and the more steady increase of Iraq have all contributed to bring Middle East production above 100 mil tons a year.

If the Far East has nothing as spectacular to show, its pre-war production has been increased by a million tons a year. Production from Seria has been maintained at 5 mil tons. Not all the Indonesian oilfields are working even yet, but the development in 1952 of the Minas field in Central Sumatra has added 1 mil tons a year to their total. To make the Far East more independent still wider efforts are going into exploration in New Guinea, Australia, Borneo, India, Pakistan, and elsewhere. Production in Japan, though small, has passed previous records owing largely to the introduction of up-to-date methods under the occupation.

Compared with the larger producing areas developments in Western Europe remain on a smaller scale. Germany is now producing 2 mil tons a year. In France and Italy natural gas is being tapped increasingly for industry. Behind the Iron Curtain production from the Vienna Basin continues to rise, and Russia is producing more oil than had been anticipated.

A comparison between production in 1946 and in 1952 in the larger areas is shown in Table I.

Exploration Development

It is never easy to see a pattern in the exploration for oil throughout the world. Since the war the need for oil has been such that exploration has been gradually spreading into any area where a chance of oil lies. It has been intensified in productive areas as much in the United States as elsewhere. Up to 1950, the growth of exploration outside the United States was relatively greater than that within it. In 1951, owing probably to the growth of nationalistic views of sub-soil rights, the trend has been reversed, and the swing is back to the United States.

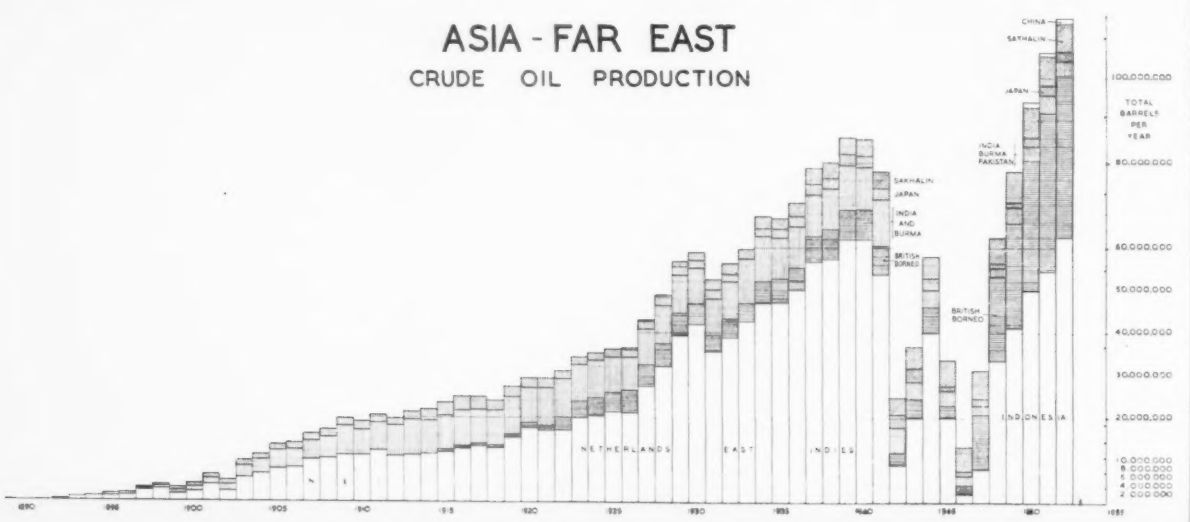


TABLE I

	Crude Oil Production, Million Tons	
	1946	1952
North America:		
U.S.A. and Canada	249.1	340.6
Caribbean:		
Venezuela, Colombia, Trinidad	62.8	103.6
Mexico	7.1	11.1
South America:		
Argentine, Peru, Ecuador, Chile	5.3	6.5
Middle East	35.5	105.5
Far East	1.2	14.9
European Area	.8	3.1
U.S.S.R.	22.8	47.4
Eastern Europe	6.2	8.4
WORLD TOTAL	390.8	641.1

One may see in perspective the impetus of Canadian and of Mexican exploration as the result of the changed status of the United States in 1947 from a net exporter to a net importer of oil. It is not altogether a coincidence that the key discovery of Leduc, which set the spark to Canadian oil, also dates from 1947; or, in view of conditions in Mexico, delayed the discovery of Ezequiel Ordonez until 1952. The intensive exploration for new oil in Venezuela since the war may be seen as the aim to produce the balance of Western Hemisphere requirements.

Exploration for oil and gas in Europe has been gradually growing in intensity since the war. Like its racial complexion, geological conditions in Europe are a patchwork. Each new discovery, like the gas strikes in Italy and France, though small in relation to the need, is vital to the nation, and leads to an intensification of the search. Political uncertainties in the Middle East are bringing the industry to look for sources of crude oil elsewhere. Exploration is being pushed into areas of secondary prospect, into North Africa and into the minor sedimentary basins that fringe the continent and into the Congo. There is greater activity in Africa than there has ever been before.

In the Far East also, in Pakistan, India, and China exploration is proceeding apace. Politics in Indonesia still prevent a return to pre-war exploration activity. Borneo and Netherlands New Guinea are redressing the balance in work and in result. There has so far been little return for effort in Australia, Papua or the Philippines. Japan has been more successful.

Geophysical Prospecting

The importance of geophysics as a medium of exploration is still growing. There were 20 per cent more seismic parties and 12 per cent more gravity in 1951 than in 1950. In 1950 the increase was more rapid in the Eastern than in the Western Hemisphere, but in the last two years, with activities in Canada and in Mexico, the trend has reversed. There have been 791 seismic and 123 gravity crews running in the world. In 1951 the percentage distribution was:—

	U.S.	*Canada*	*Western Hemisphere*	*Eastern Hemisphere*
Seismograph, %	69	16	90	10
Gravimeter, %	54	10	77	23

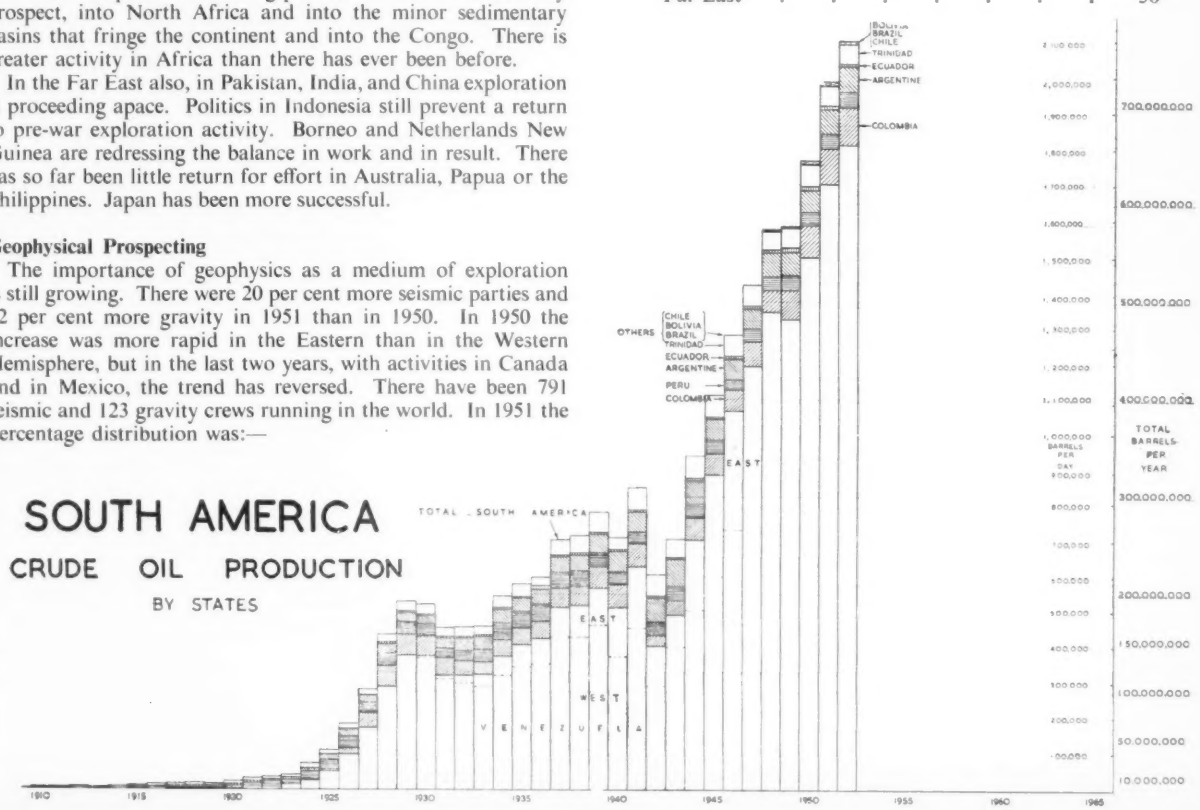
The justification for this investment in geophysical work may be seen in the 1947-51 "success ratio" in the U.S. for geological and geophysical methods combined:—

Basis	*Success Ratio*
Non-technical (random drilling)	1 : 30
Geological	1 : 10
Geophysical	1 : 6
Geological and geophysical combined	1 : 5

Drilling Activity

The difficulty of distinguishing a true exploration well or "wildcat" from a semi-exploration or a field outstep makes figures unreliable. But as an index of activity at the end of 1952 the number of rigs running in different parts of the world, outside the U.S.A. and Canada, makes an impressive total of 585.

United States		3032
Canada		177
South America:		
Mexico	80	
Venezuela	131	
Argentine	45	
		268
Europe:		
Germany	95	
France	28	
Italy	24	
		166
Africa		26
Middle East		38
Indonesia		31
Far East		56



Continental Shelf

The exploration and development of the Continental Shelf may be seen as another notable advance of the mid-century. Tidal, even off-shore, drilling has been done since the '80s, off Summerland, California; and the Lake of Maracaibo drilling marks the '20s and '30s. But the geophysical marine exploration of the Continental Shelf off Texas and Louisiana, and the drilling there, off Borneo, and in the Persian Gulf mark the late 40s and the '50s.

Oil developments in the Gulf Coast are leading to research into the nature and thickness of the sediments and basement comprising the Continental Shelf in the Caribbean. An expedition representing the Lament Geological Observatory, affiliated with Columbia University, sailed in April/May 1952 from Texas to Jamaica and Trinidad. Two vessels were equipped by the Woods Hole Oceanographic Institution for seismic refraction work, and for core and deep water sampling for this research.

The years 1951-52 have seen off-shore drilling in the Persian Gulf and off Borneo. Off Saudi Arabia, Safaniya No. 1 was drilled 12,000 feet out to sea; a Seria well has been sited 5000 feet from the beach on which wells have long been drilled. Another beach well, Tortugero No. 1 near Vera Cruz, Mexico, deflected seawards, may lead to sea drilling.

The Law

The legal position of the ownership of oil and other minerals that lie beneath the high seas continues to provide sport for international lawyers. While it is generally agreed that the coastal state should alone have rights over the Continental Shelf—in support of the "diplomatic" doctrine which various states have assumed—the definition of the shelf and the nature and extent of the rights over it are under discussion.

A small legal point has arisen in the case of Trinidad Petroleum Development Co. whose articles of association defined its sphere of activity "within the Colony". An extraordinary general meeting was held early in 1953 to adopt new articles to ensure the company's legality in developing marine areas.

In 1952 there was a change of lessee over the 12-mile belt lying outside the territorial waters of the Qatar Peninsula in the Persian Gulf. This passed to Shell from the Superior Oil Company which has also surrendered its rights to its marine concessions off the Trucial Coast.

Big-inch Pipelines

There is little doubt that the coming in the early '40s of the big-inch pipeline (that is 24 inches diameter and over) will be seen as another advance in the mid-century. The first was laid to save a sea tanker haul in the war from the Gulf Coast to Pennsylvania. In the United States since then over 100,000 miles of big-inch have been laid, in 1951 alone 25,000 miles. The first big line to be laid outside the United States was the trans-Arabian "Tapline" to save the haul by some sixty 16,000-ton tankers round 3300 miles of the Arabian Peninsula. The present throughput of this line is 15 million tons a year. In the last two years several large lines have been laid to render economic oil and gas fields far from seaboard, as in Alberta and in Iraq. Recently completed lines are:—

		Miles	*Diameter, Inches*
Canada:			
1951	Edmonton—Lake Superior	1150	16-20
1953	Edmonton—Vancouver	711	24
	Lake Superior—Sarnia	635	30
Venezuela:			
1951	Palmarejo—Cardon	158	30
1952	Lake Fields—Amuay	143	26
	North Guarico—Caracas	190 (gas)	10-16
Iraq:			
1952	Kirkuk—Banias	556	30
1953	Ain Zalah—Kirkuk System	140	12
	Zubair—Fao	65	24

The construction of lines of this size, whether or not in undeveloped parts of the world, implies a highly specialized form of engineering, requiring material, technical and financial resources of a high order. The big-inch lines outside the United States have so far been used exclusively for the movement of crude oil, but they could be used equally for natural gas, as for a Middle East—Europe project which has recently been put forward.

This is of a big-inch pipeline from the Middle East (Kirkuk) across Turkey, the Straits, through Jugoslavia to Trieste and to Paris via the Brenner and South Germany. Two parallel lines, each with a capacity of 500 million cubic feet daily, would be laid as follows:—

1,800 miles	34-36 inches diameter
700 miles	24-26 inches diameter
2,500 miles	

Branch lines would lead to the various national industrial centres en route. Modern engineering makes such a project possible, but whether the political difficulties could be overcome is another matter. The cost of such a line is put at $775 million; and it would take three years to build.

Reserves

The change in 1947 in the position of the United States from being a net exporter of oil to being a net importer has inspired reviews of the oil resources of the States and of the world as well. How far an American's conception of the world situation is influenced by that within the United States must be left to conjecture.

Recently the Americans have examined the problem from two angles: from that of raw material reserves generally, and from that of the energy sources of the world. In January 1951, President Truman set up a "Materials Policy Commission" whose report, the Paley Report, suggested that with consumption increasing at its present rate, the future of world oil supplies could give reason for concern. It is expected that by 1975 the world's oil consumption will have doubled to 1350 mil tons a year (27 mil b/d), that of the United States being 685 mil tons a year (13·7 mil b/d). Apart from imports from Venezuela and the Middle East the United States will, it is assumed, come to depend on secondary sources to the extent of 150 mil tons a year, (3 mil b/d), equally derived from shale and coal.

In a review of the energy sources of the world another American view maintains that United States production will have reached a peak by 1960-67. The only event likely to postpone this peak would be major discoveries on the Continental Shelves. The United States must therefore come to rely on sources such as, the Colorado oil shales and the Athabaska tar sands, for the balance of its needs, a source good for 160 years. Though imports will continue to come from abroad, the authors remind us that the "relative depletion" of areas, nearest to the United States is rising rapidly. The "relative depletion" of various areas is put at: United States 61 per cent, Venezuela 38 per cent, Persia 20 per cent, Iraq 5 per cent, Kuwait 2 per cent.

To these American opinions a British has recently been added. In a review of the distribution of the oil reserves of the world Lees and Ion have made an estimate of the oil that will be discovered before 1972 in relation to consumption. Thus:—

	World Proven Reserves, 1951		*Total Oil Available up to 1972*	
	Million Tons	*Per cent*	*Million Tons*	*Per cent*
North America	4,520	31	10,000	24
South America	1,620	11	5,000	12
Middle East	6,900	48	20,000	49
East Indies	240	2	1,000	2·5
Russia	1,000	7	4,000	10
Others	170	1	1,000	2·5

With consumption in 1951 at 600 mil tons, and given an increase of 4 to 5 per cent per year, the total requirements for 1952-72 will be 19,000 mil tons. On the basis of these figures reserves in 1972 will be about 16 times the annual consumption against 24 times today. Should consumption increase as it has done in the past by 6·6 per cent per year, proven reserves in 1972 will be only nine times the annual consumption, a very low working margin.

What is of special interest about these views, whether British or American is the opinion, that the industry may have to consider secondary sources of oil, oil shale, tar sands and possibly coal, within the next twenty years to meet the demand. And it may be this undercurrent of feeling that has led to the continued interest of the U.S. Bureau of Mines in the Colorado Oil Shales and in the last year to extensive leasing of the tar sand deposits on the Athabaska River.

On the other hand the tendency to base an opinion on the amount of oil, or of coal for that matter, remaining underground, on what is known at the time estimates are made, has been recurrent for 50 years, and has been gathering force in the last 30. The fact is that it is easier to estimate the world's future consumption than to apply statistical methods to natural resources of which there may not be much evidence. And the opinion can be held that in spite of the advances in geophysics, the industry is still in the early stages of its application, and in 50 years time our methods will be seen as primitive as the torsion balances of the first decade of the century.

In the world outside the United States the main increase in reserves has been in the Middle East, in Canada, and possibly in the U.S.S.R. The increase in the Middle East comes mainly from Saudi Arabia, from the Magwa extension to Kuwait's Burgan field, and from Zubair, Iraq. Venezuela also shows an increase, but significantly in the last year new oil has hardly equalled heavy withdrawals. The immense increase claimed by Russia may or may not be real. In Europe, Germany and Austria show appreciable if small gains, other areas normal routine increases. A contrast between 1947 and 1952 shows:—

	Per cent of World Total	
	1947	1952
United States	31	23
Middle East	41	55
South America	16	9
Russia	9	8
Rest of World	3	5

TABLE II

WORLD CRUDE OIL RESERVES

Thousand barrels

	Estimated Proven Reserves	*Ratio of Proven Reserves to 1952 Production*
	1952	*Years*
North America:		
United States	27,537,000	12
Canada	1,800,000	29
Mexico	1,525,000	19
Total	30,865,500	12
Caribbean:		
Venezuela	8,900,000	13·5
Colombia	470,000	12
Trinidad	250,000	11·8
South America:		
Argentina	330,000	13·2
Chile	45,000	49·2
Peru	250,000	15·2
Middle East:		
Bahrein	290,000	26·3
Persia	15,000,000	—
Iraq	12,000,000	86·1
Kuwait	20,000,000	72·9
Qatar	1,500,000	60·0
Saudi Arabia	16,000,000	52·0
Egypt	155,000	9·5
Total	64,825,000	84·5
Far East:		
British Borneo	500,000	13·0
Burma	140,000	166·2
Indonesia	1,300,000	21·2
Japan	25,000	11·6
New Guinea	50,000	29·1
Europe:		
Germany	200,000	16·7
Netherlands	75,000	15·0
France	30,000	11·6
Iron Curtain:		
Russia	9,000,000	26·3
Rumania	275,000	8·8
Austria	160,000	9·3
WORLD TOTAL	118,151,200	26·2

Note: The totals also include lesser areas not shown.

Oil and Gas Journal, 22 December 1952, p. 184.

Oil Law

The 50 : 50 Agreements

The application of the principle of equal sharing of profits between producing companies and producing countries, first reached in 1943 between the Government of Venezuela and the industry there, has been widely adopted during 1951 and 1952, and has become the basis of development contracts in the Middle East. Existing contracts have been revised with Saudi Arabia, Iraq and Kuwait (1951) and with Bahrein and Qatar (1952). The recent agreement between the Sheikh of Qatar and Shell relating to a marine concession beyond territorial waters is the first to be negotiated on the basis that if oil is discovered in commercial quantities a 50 : 50 basis will apply.

Historical Summary 1945-1952

This table summarizes some of the more important events that have contributed to crude oil developments since the war. Their selection is in many respects arbitrary. Considered historically the discovery of a small oilfield in a new area, like Alaska or Tierra del Fuego, may have greater significance than additions to the many existing fields in Canada or in Eastern Venezuela. The event of importance is not only the increase of crude oil production in every part of the world, but the world's increasing reliance on Middle East oil.

1945

World crude oil production 367·8 *mil tons*
Per cent from Middle East 7·3 *per cent*

May	Egypt: Sudr oilfield discovered, the first on Sinia Peninsula.
September	Continental shelf of U.S.: President Truman's proclamation.
—	Saudi Arabia: Qatif oilfield discovered.
December	Chile: oil struck in Tierra del Fuego, the Manantiales field.

1946

World crude oil production 390·8 *mil tons*
Per cent from Middle East 9·1 *per cent*

January . First post-war crude oil shipments from British Borneo to Australia.
March . . U.S.S.R. fourth five year plan announced (1946-1950).
March . . Borneo: drilling is resumed in the Seria field.
June . . Kuwait: first shipment of crude oil.
September . Nigeria: prospecting licenses granted in 1938 revived by Colonial Secretary.
December . Middle East oil agreements for rational development reached between Standard, Vacuum, Texas, and A.I.O.C.

1947

World crude oil production 432·2 *mil tons*
Per cent from Middle East 9·8 *per cent*

— United States, after 90 years a net exporter of oil becomes for first time a net importer.
January . France: Monnet Plan launched to rehabilitate basic industries by 1952.
February . Canada: Leduc No. 1 blows-out from Devonian D-2 limestone.
— Bahamas: survey of Bahamas Banks in progress by five major companies.
— Venezuela: deep limestone production from West Maracaibo fields (discovered 1944) reaches 35 mil barrels/year.
December . Egypt: Sudr oilfield starts production.

1948

World crude oil production 489·0 *mil tons*
Per cent from Middle East 11·8 *per cent*

January . Egypt: Asl oilfield discovered.
— Borneo: Seria oilfield producing at rate of 22 mil tons a year.
— Venezuela: "big-inch" oil line completed from Lake fields to Paraguana Peninsula, Amuay Bay.
March . . Turkey: Ramandag field proved commercial; production started.
April . . Israel: Haifa refinery closed down.
April . . Israel: Southern limb of Iraq pipeline closed down owing to Israel-Arab war.
June . . Kuwait/Saudi Arabia Neutral Zone: American Independent secure concession covering Sheikh of Kuwait's undivided half interest.
June . . Rumania: balance of private industry "nationalized."
July . . . Saudi Arabia: Ain Dar field discovered.
August . . Mexico: Reynosa oilfield discovered, the first in North Mexico.
August . Colombia: Difical oilfield in production.
September . Hungary: properties of foreign interests MAORT and others "nationalized."
October . Canada: Redwater field discovered; drilled-up and producing half Canadian production 1952.
November . Iraq: Zubair field discovered.
December . New Guinea: first shipment of oil from Klamono field, Netherlands New Guinea.

1949

World crude oil production 485·6 *mil tons*
Per cent from Middle East 14·6 *per cent*

— Middle East: crude oil production surpasses that of Venezuela, and is major source of supply for Eastern Hemisphere.
— Ecuador: Exploration for oil in Oriente is given up by Shell and Standard who withdraw.
February . Kuwait/Saudi Arabia Neutral Zone: Pacific Western secures concession rights for Saudi Arabia's half interest.
March . . Mexico: again allows entry of foreign capital for oil development.
March . . Austria: Matzen structure discovered in 1938 developed into oilfield under Soviet control.
March . . Saudi Arabia: Fadhili and Haradh oilfields discovered.
June . . Italy: discovery of Cortemaggiore gas field leads to wide use of natural gas and to pipeline system throughout Northern Italy.
June . . Iraq: Zubair oilfield discovered.
October . Argentine: gas line from Comodoro Rivadavia to Buenos Aires completed.
December . Chile: pipeline from Cerro Manantiales to sea completed, allowing first shipment of oil from Tierra del Fuego.
December . Qatar: completed pipeline allows first shipment of oil from field discovered in 1940.

1950

World crude oil production 543·4 *mil tons*
Per cent from Middle East 16·3 *per cent*

— Germany: Emsland oilfields produce more than Hanover fields but not more than all fields on Hanover-Hamburg axis.
February . France: Lacq oilfield discovered.
June . . Korean war started.
— Alaska: Umiat oilfield discovered in Naval Reserve No. 4.
— Chile: two oilfields discovered in Tierra del Fuego.
November . Canada: Edmonton-Lake Superior 16-20 inch pipeline completed.
December . Middle East: Tapline completed.
— Saudi Arabia: Aramco concludes first 50 : 50 Agreement in Middle East.
— Netherlands: Schoonebeek oilfield producing at 700,000 tons a year.

1951

World crude oil production 609·4 *mil tons*
Per cent from Middle East 16·0 *per cent*

— Borneo: Seria field producing 5 mil tons a year.
— Italy: continued discoveries of natural gas leads to growth of pipeline network throughout Northern Italy.
May . . Saudi Arabia: Uthmaniyah area discovered.
July . . . Persia: Abadan closed down.
August . Saudi Arabia: Safaniya oilfield, first off-shore in Persian Gulf discovered.
August . . Colombia: De Mares concession (Tropical Oil Co.) reverts to government.
— Alaska: Umiat oilfield proven, and gas struck in Gubik area in Naval Reserve No. 4.
November . Colombia: Totumal No. 1 completed; first Cretaceous strike in Magdalena Valley.
December . Kuwait: Magwa well extends Burgan field 7 miles north.
— Venezuela: "big-inch" oil line completed from West Maracaibo fields to Cardon refinery on Paraguana Peninsula.

1952

World crude oil production 641·1 *mil tons*
Per cent from Middle East 16·5 *per cent*

— Middle East: crude oil production exceeds rate of 100 mil tons per year.
January . Venezuela: crude oil production exceeds rate of 100 mil tons per year.
February . Canada: construction starts on Transmountain Pipe Line, Edmonton to Vancouver, B.C.
March . . Peru: new oil law is passed encouraging application for concessions, especially in coastal province.
April . . Iraq: Kirkuk-Banias 26/30/32-inch pipeline starts up.
April . . Indonesia: Minas oilfield, Sumatra, starts production.
August . Indonesia: crude oil production passes pre-war rate of 8.5 mil tons a year.
August . Mexico: Ezequiel Ordonez oilfield discovered.
September . Iraq: Ain Zalah-K.2 Baiji 12-inch 135-mile pipeline completed and starts operation.
October . Canada: Redwater field drilled up and producing third of Canadian production.
November . Pakistan: gas struck at Sui, Indus Valley, at 10,049 feet.
November . Germany: crude oil production reaches rate of 2 mil tons a year.
December . Turkey: invites foreign interests to share development of her oil resources.
December . Saudi Arabia: Ain Dar, Uthmanijah, and Shedgum areas ascertained as a single oilfield now called Ghawar.
December . East Africa: Shell D'Arcy starts joint survey in coastal areas of Kenya, Tanganyika, and Zanzibar.
December . Qatar: Shell acquires concession covering off-shore areas round Qatar peninsula.

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Around the Branches

FAWLEY, LONDON, NORTHERN, PERSIAN GULF, SCOTTISH, SOUTH EASTERN, SOUTH WALES, STANLOW, TRINIDAD

London Branch

December 17 1953 was the fiftieth anniversary of the first successful powered, controlled flight in a heavier than air machine by Orville Wright in America, and as this date coincided with the pre-Christmas film show which has become customary in the Branch's calendar, it seemed appropriate to organize a joint meeting of the Branch with the London Graduates section of the Royal Aeronautical Society. A film called "Powered Flight—the Story of the Century" had been produced by the Shell Film Unit with the guidance of the Royal Aeronautical Society to celebrate the fiftieth anniversary, and all the ingredients were therefore to hand for an enjoyable function.

On the evening some 150 members of both organizations with wives and friends came to the meeting. The Branch Chairman, A. W. Deller, presided, and after introducing the chairman of the Royal Aeronautical Society Graduates, J. G. Roxburgh, he briefly outlined some of the details of the making of the film.

The film, which ran for 53 minutes, was then shown. It consisted almost entirely of contemporary cinematograph records of all the outstanding events and developments in aviation throughout the 50 years since the first successful flight at Kitty Hawk. An extraordinary variety of this material has been discovered, often in unexpected places, and one of the principal difficulties in making the film has been the selection of the best material from an almost bewildering variety of interesting and significant shots.

Following the showing of the film, Mr Roxburgh expressed briefly the appreciation of the Royal Aeronautical Society Graduates at the success of this first joint meeting which he hoped would lead to others. To round off the evening 50 members and friends of both organizations had an informal dinner at the Bolivar Restaurant.

Northern Branch

On 15 December members of the Northern Branch foregathered at the Warner Brothers Trade Theatre in Manchester for a film evening. The three films shown were "The Wealth of the World—Oil," "Our Forest Heritage," and "1952 T.T. Race." They were enthusiastically received and the chairman, J. C. Wood-Mallock, expressed the thanks of the Branch to all who had contributed to the success of the evening.

Not the least enjoyable part of the evening was the Lancashire Hot-Pot Supper which followed the film show and was held at the Nags Head Hotel. This was in turn followed by light entertainment by two well-known local characters.

Scottish Branch

Mr J. M. Caldwell, J.P., chairman of the branch, presided at a meeting held in Grangemouth on 10 December 1953 and introduced H. Hyams, of The Shell Petroleum Co., who, he said, was chairman of the Finance Committee, chairman of the Subcommittee on Measurement and Sampling, and a member of the Standardization Committee, all of the Institute of Petroleum. He was an acknowledged authority on all matters relating to measurement of oil products, and had travelled all over the world in this connexion. He was, therefore, well equipped to speak on his subject—"International Standardization of Bulk Petroleum Measurement and Quality Testing".

In his address, Mr Hyams dealt first with the importance which must be attached to the skill of the laboratory chemist and the use of well founded and widely accepted testing procedures in the evaluation and quality control of petroleum products. Emphasis was laid on the attention being continuously devoted by the oil industry to the evolving of new and improved methods in order that there might be the closest possible co-ordination between the results produced by the laboratory chemist and the practical results obtained when a product was used, say, in an engine or in a piece of machinery or equipment. He concluded this section of his address with a brief description of the activities of the Institute of Petroleum and the American Society for Testing Materials in the field of production of standardized petroleum test methods; and described the co-operative work which had been and was being carried out by those two bodies.

The second and larger part of the address concerned standardization related to bulk oil measurement, *i.e.*, the standardized processes involved in measuring a quantity of liquid petroleum. As he said, the final objective of accurate oil measurement is "its significance in the honest prosecution of the business of producing, buying, and selling oil; and the need for controlling stocks of oil and losses in storage, transport, and distribution."

He indicated that three standards of accuracy in oil measurement were generally required for different purposes; (a) simple and reasonably accurate methods for internal refinery operations; (*b*) more accurate methods for evaluating oil quantities sold and purchased; (*c*) very accurate methods for loss control or referee work.

Attention was devoted to brief descriptions of standardized apparatus and procedures for (1) tank calibration; (2) measurement of oil depths in shore tanks; (3) temperature measurement; (4) specific gravities; (5) measurement in pipelines; (6) ships' measurements; (7) the use of meters in oil measurement; (8) calculations.

Since errors in measurement tend to obscure real losses, accurate measurements were important in estimating storage, transport, and handling losses. Systematic errors, because they might be cumulative, were more important than fortuitous errors. It was only when the cause of the loss and its amount were clearly known that consideration could be given to means for its reduction. He showed that with the increasing values of petroleum products more and more attention was being given to loss control. The importance of educating and training staff and labour concerned with oil measurement and with all the operating processes connected with the storage and movement of products was fully realized with oil companies.

Mr Hyams concluded with a reference to collaboration in oil measurement standardization over the past 20 years and indicated the fruits of this co-operative work. Referring to the recent production of three volumes of oil measurement tables bearing the joint imprints of IP and ASTM, the author's final words were: "The production of these volumes was a monumental task shared equally by the two bodies—an example to all industries of the true meaning of the word 'co-operation'."

The reading of the paper was followed by a lively discussion and the meeting concluded with a vote of thanks to the speaker.

South Eastern Branch

The meeting on 3 November 1953 took the form of a Brains Trust, with N. W. Grey, chairman of the Branch, presiding, the Panel consisting of Dr J. E. Carruthers, Mr Elcomb, J. H. Evans, and L. R. Rope. Twenty questions covering a wide variety of subjects were asked and competently answered. At the conclusion of the meeting, F. A. Maliphant proposed a vote of thanks to the Panel for their excellent efforts.

South Wales Branch

At the meeting on 3 December 1953 the chair was taken by C. M. Dalley, the speaker was G. D. Curtis, power engineer, National Oil Refineries Ltd., and the subject was "Services for refinery operation."

Mr Curtis, in introducing his talk, mentioned the fact that, although sanitation and drainage were a most essential service, he did not propose to deal with this lesser subject.

Mr Curtis, in the course of his talk, discussed boilerhouse practice in a very general way, an explanation of the very exacting control of furnaces, the necessity for careful examination and control of boiler feed water, stressing the fact that, under certain conditions, it was necessary to treat such water prior to introducing it to the boiler system. He next dealt with the distribution of electrical power, and with the aid of diagrams and charts showed how electric power was distributed and broken down to suit refinery requirements, and how safeguards were made for automatic control and introduction of alternative supplies should a particular source develop a fault.

Mr Curtis's talk was well-prepared, and a very interesting series of diagrams and charts were displayed.

A lively and interesting discussion followed and a vote of thanks was proposed by Dr M. Benger.

Stanlow Branch

A lecture entitled "Manufacture and applications of grease" was given by Dr J. B. Matthews on 16 December 1953.

The speaker considered the structure of greases, particularly as revealed by investigations into phase changes conducted by such methods as differential thermal analysis. For second order phase changes where latent heat was not involved physical properties such as viscosity, etc., were the criterion.

The use of microscopy and electron-microscopy in grease investigation was discussed and the characteristics of grease fibres and the dependence of grease properties thereon explained.

The lecture was largely based on the author's recent paper in the Institute's *Journal* (1953, p. 265), the diagrams from which were shown on the screen.

The discussion was opened by J. C. Cragg; after a vote of thanks from the chair the meeting closed at 9.30 p.m.

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STANDARD METHODS

The Standardization Committee of the IP are desirous that users of "Standard Methods for Testing Petroleum and Its Products" who find errors or misprints should notify the Institute without delay in order to avoid repetition in the next edition. Such information should be sent to the Technical Assistant at 26 Portland Place, London, W.1.

A correction already noted is in the method for soluble bitumen content rapid method for asphalt, IP 140/53, page 503, para (g), line 3 — for "500" read "5000".

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CRUDE OIL PRODUCTIONS

	November 1953 *Tons*	*Jan. to Nov.* 1953 *Tons*
Kirkuk—Iraq Petroleum Co. Ltd. .	1,914,057	20,890,886
Zubair—Basrah Petroleum Co. Ltd.	256,447	2,770,479
Ain Zalah—Mosul Petroleum Co. Ltd.	83,137	1,174,910
Qatar—Qatar Petroleum Co. Ltd. .	265,751	3,654,955
Kuwait—Kuwait Oil Co. Ltd. . .	3,360,835	38,620,002

COUNCIL COMMENTARY

For some years now we have endeavoured to give a brief and, we hope, interesting account of the proceedings at the monthly Council meeting. These meetings vary, both in personnel and in the numbers who are able to attend, as well as in the matters discussed. Sometimes the agenda contains little to interest the average member and at others contains many interesting items. Sometimes Council is in acquiescent mood and agrees to most things put before it; at others it is argumentative and discusses many things at length.

The meeting held on 9 December 1953, with the President in the chair, was one of the former kind and terminated before 4.30 p.m., which must be a record for Council meetings.

The General Secretary announced that His Royal Highness, the Duke of Gloucester, had graciously consented to attend our next Annual Dinner on 24 February. This is a great honour for the Institute and will no doubt result in the demand for tickets being even greater than usual.

The date of the next World Petroleum Congress has also been finally decided and this event will now take place in Rome during the period 6-15 June 1955. Papers are already being collected and a preliminary conference to discuss the programme was held in Rome last month.

There have been until now two medals which the Institute awards at intervals to outstanding personalities in the Petroleum Industry. A third medal has now been founded—the Eastlake Medal—to commemorate the Institute's Co-founder. Council have decided that the first award of this new medal is to go to Mr G. H. Coxon, our Honorary Treasurer, who has given many years of hard work for the benefit of the Institute, and to make Mr T. Dewhurst an Honorary Fellow. Some discussion took place as to the occasion on which the Eastlake Medal and Honorary Fellowships and Honorary Memberships should be conferred and it was agreed that in future, such events should take place at the Annual General Meeting. Council also decided to award the Cadman Medal to Mr C. A. P. Southwell, C.B.E., M.C., our immediate Past-President, in the autumn of 1954, and to invite him to deliver the Cadman Memorial Lecture on that occasion.

The growth of the refining industry in the U.K. has raised problems of air and water pollution, which all concerned are doing their best to minimize. The Inspector of Alkali, etc., Works, whose department is responsible for keeping such pollution within reasonable limits, has suggested that an exchange of views among the oil companies and other parties interested would probably be very helpful in the present circumstances. Papers Sub-Committee are, therefore, to try and arrange a symposium on this matter at the earliest possible date.

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An Anglo-Iranian Photo.

The British Oak, *launched in May* 1953 *for the British Tanker Co., on her maiden voyage from the Kent Oil Refinery with* 14,000 *tons of diesel and fuel oil for Fremantle, Western Australia.*

The Redwood Medallist 1953

Dr F. P. Bowden receiving the Redwood Medal from the President and (right) *signing the book of honour.*

F. P. Bowden, Sc.D., F.R.S., Redwood Medallist, 1953.

F. P. Bowden, Sc.D., F.R.S., who was presented with the Redwood Medal of the Institute of Petroleum on 2 December 1953, was born in Tasmania and took his Master of Science degree in Physics at the University of Tasmania in 1926. He then came to Cambridge and took his degree of Doctor of Philosophy and was elected Fellow of Gonville and Caius College in 1929. He was appointed Humphrey Owen Jones Lecturer in Physical Chemistry in 1937 and Reader in Physical Chemistry in 1946. He received the Cambridge Sc.D. degree in 1934 and was appointed a Fellow of the Royal Society in 1948. His researches are mainly on surface phenomena and range from the mechanism of electro-desposition to the initiation of explosives. He is particularly interested in the problem of friction. During the war he was borrowed by the Australian Government and was in charge of the Tribophysics Division of the Commonwealth Scientific and Industrial Research Organization, Australia, from 1939 to 1945. Apart from numerous publications in scientific periodicals, he has published two books: "The Friction and Lubrication of Solids" 1950 (with D. Tabor) and "The Initiation and Growth of Explosion in Liquids and Solids" 1952 (with A. D. Yoffe). In addition to being Reader in Physical Chemistry, he is also head of the Research Laboratory for the Physics and Chemistry of Surfaces.

Prior to receiving the Redwood Medal from the hands of the IP President, H. S. Gibson, C.B.E., Dr Bowden delivered a discourse on "The Friction of Solids" to a large gathering of members of the Institute and visitors. During the course of his lecture Dr Bowden demonstrated various points by the use of apparatus and models and showed many interesting and pertinent lantern slides.

Welcoming Dr Bowden to the ranks of the Redwood Medallists, Mr H. S. Gibson, himself a Redwood Medallist, remarked that Dr Bowden was the tenth recipient of the Medal and the first non-member of the Institute to be so honoured. He recalled that the Medal had been introduced in honour of the Founder-President of the Institute, whose work on viscosity was closely related to Dr Bowden's work.

Accepting the Medal, Dr Bowden expressed his great appreciation of the honour which had been conferred upon him. He wished the award to be regarded not only as a recognition of his work on friction and lubrication, but also as a joint award to his assistants and colleagues. The Medal should be regarded as an award to his Laboratory.

After the meeting the Redwood Medallist was entertained at dinner by the Council of the Institute, the chair being taken by the President.

At the dinner given in honour of Dr Bowden, his health was proposed by the President, H. S. Gibson, C.B.E. (left). *Among the Members of Council present were: (centre) G. H. Thornley, D. L. Samuel, F. L. Garton, H. Hyams, Dr C. G. Williams, and* (right) *Col S. J. M. Auld, O.B.E., M.C., and* (extreme right) *E. A. Evans.*

Chemical Engineering

PART VII—ABSORPTION AND STRIPPING

By D. C. FRESHWATER

Introduction

Gas absorption may be defined as the transfer of gas or vapour from a gas phase into a liquid phase in which it is soluble. The term gas absorption is applicable not only where one component is dissolved but also where a number of different components are dissolved to different extents. In petroleum refining the most important absorption process is the treatment of natural gas or refinery gases to recover the low-boiling hydrocarbons such as propane, butane, and higher, and in some cases the corresponding olefins. This can be effected by bringing the gases into contact with some suitable absorbing liquid in which the desired hydrocarbons are preferentially dissolved whilst the unwanted gases such as methane and ethane pass through undissolved. This method is used particularly for gas mixtures relatively weak in hydrocarbon vapours where the cost of recovery by other methods such as compression accompanied by refrigeration would be prohibitive because of the large volume of gases to be handled.

Absorption is one of the most important unit operations in refining. In practice it is invariably followed by an operation known as stripping, in which the light hydrocarbons are separated from the absorbing liquid, the latter being used again in the absorbers. This combination is illustrated in Fig 1. In absorption

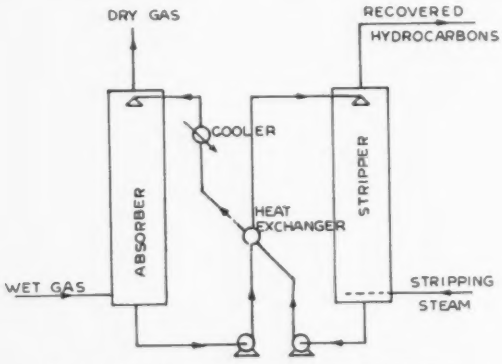

Fig 1. *Simple line diagram of typical absorption process.*

terminology the gas entering the absorber is called "wet gas" and that leaving, "dry gas." The liquid entering the absorber is practically free from dissolved light hydrocarbons and it is termed "lean oil," whilst that leaving the absorber and passing to the stripper is called "fat oil," since it is rich in the hydrocarbons dissolved out of the wet gas.

Absorption Theory

Absorption is similar to fractionation in that liquid and gas are contacted and brought into equilibrium but the main difference is that in absorption, equilibrium is obtained by the transfer of material from the gas phase only. Ideally (and also for most practical purposes) there is no corresponding transfer of material from the liquid phase into the gas. In the discussion of the underlying principles which follows it will be assumed for simplicity that only one component of the gas is absorbed. Moreover, we shall consider only those cases where solution takes place as distinct from a chemical reaction between the absorbed constituent and the liquid.

Gas Solubility

Some gases are more soluble than others in a given liquid under the same conditions of temperature and pressure; this can be expressed more precisely by stating that a solution of a gas in a liquid at a fixed concentration and temperature exerts a definite partial pressure of the dissolved gas, and that different gases show marked differences in the partial pressures that their solutions exert at equilibrium. Generally the lower the partial pressure of the dissolved gas from a solution of given concentration, the more soluble it is said to be. Expressed mathematically the relation between partial pressure and concentration is:—

$$p = Kc \qquad . \; . \; . \qquad (1)$$

where p is the partial pressure of the dissolved gas.
c is the concentration of the dissolved gas.
and K is the proportionally constant of concentration.

In general K depends both on concentration and temperature but in many practical cases it may be considered as a function only of temperature. Equation (1) then becomes Henry's Law, and is written as

$$p = Hc \qquad . \; . \; . \qquad (2)$$

where H is the Henry's Law constant which is fixed for any particular temperature.

It should be noted that the relation between concentration and partial pressure in equations (1) or (2) represents conditions at equilibrium. At this equilibrium the liquid contains the maximum concentration of dissolved gas that can be obtained for a given partial pressure of this gas in the gas mixture. The equilibrium can be changed in the direction of increasing solubility by increasing the total pressure and this effect becomes appreciable at pressures above 3 or 4 atmospheres. Practically all absorbers used in petroleum refining take advantage of this fact and operate at moderately high pressures.

Diffusion and Rate of Absorption

Consider now the flow of a soluble constituent of a gas mixture into a liquid. Conditions may be thought of as analogous to those obtaining in heat transfer between two fluids (see article on heat transfer) except that in this case there is on retaining wall between the fluids. The conditions are shown diagrammatically in Fig 2. The soluble gas has to diffuse through the

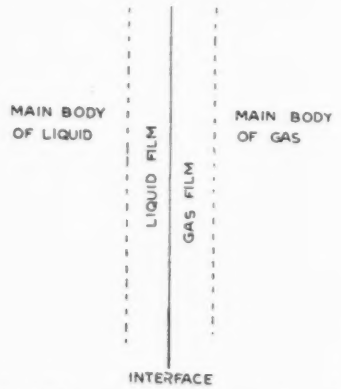

Fig 2. *Diagrammatic representation of film resistances.*

main body of the gas and before reaching the interface between gas and liquid has to pass through a stagnant gas film. The gas must then diffuse through a stagnant liquid film and so into the main body of the liquid. At the interface between the two films equilibrium exists between the gas and liquid, i.e. p in the gas is equal to K or H times its concentration in the liquid. Again, as in heat transfer, the rate of diffusion of the gas per unit area of interface will be directly proportional to the resistance.

In gas absorption the driving force may be expressed either as a concentration difference between the interface and the main body of the liquid or as a difference in partial pressures between the interface and the main body of the gas according to which film is being considered. The resistance is represented by the film thicknesses. This may be written as an equation by the insertion of the usual proportionality constant, in this instance called a coefficient of diffusion, thus:—

$$N_x/A = \frac{D_m(P_x - P_{xi})}{(P_y)_{av} B_g} \quad \text{for the gas film} \quad . \; . \; . \quad (3)$$

where N_x = the number of moles of x diffusing per unit time.
A = unit area perpendicular to the direction of diffusion.
P_x = the partial pressure of component x in the main body of gas.
P_{xi} = the partial pressure of component x at the interface.
$(P_y)_{av}$ = the average partial pressure of the inert components in the gas film.
B_g = the thickness of the gas film.
D_m = coefficient of diffusion.

Similarly for the liquid film:

$$N_x/A = \frac{D_L(C_{xi} - C_x)}{B_L} \quad . \; . \; . \quad (4)$$

where C_{xi} = the concentration of x at the interface.
C_x = the concentration of x in the main body of liquid.
B_L = the thickness of the liquid film.
D_L = the coefficient of liquid diffusion.

Since the film thickness cannot be measured these expressions are usually simplified by introducing a film coefficient of mass transfer in place of the diffusion coefficient and film thickness. Thus:—

$$N_x/A = k_g(P_x - P_{xi}) = k_L(C_{xi} - C_x) \quad . \; . \; . \quad (5)$$

where $k_g = \frac{D_m}{(P_y)_{av} B_g}$ and is the gas film coefficient.

and $k_L = \frac{D_L}{B_L}$ and is the liquid film coefficient.

In practice the solubility data are usually known and P_x and C_x are fixed by the operating conditions. Therefore, if k_g and k_L are known, P_{xi} and C_{xi} can be calculated. Whilst k_g values can be predicted fairly readily, it is not possible to calculate accurate values of k_L owing to the greater complexities of liquid diffusion and very few experimental data exist. It is usual, therefore, to combine the individual film coefficients into an overall coefficient as is done in heat transfer, since it is much easier to determine experimentally the values of overall coefficients.

The overall coefficient may be in two forms depending upon wherever the driving force is expressed in terms of liquid concentration or partial pressure. Thus:

$$N_x/A = K_g(P_G - P_L^*) = K_L(C_G^* - C_L) \quad . \; . \quad (6)$$

where K_G and K_L are the overall coefficients of mass transfer
P_G is the partial pressure of the soluble component in the gas;
P_L^* is the partial pressure of the soluble gas in equilibrium with liquid of concentration C_L;
and C_G^* is the concentration of liquid which would be in equilibrium with a gas whose partial pressure was P_G.

It can be shown that where Henry's Law holds:—

$$1/K_G = 1/k_g + H/k_L = H/K_L \quad . \; . \; . \quad (7)$$

If partial pressures are expressed in atmospheres and liquid concentrations in grammes per cubic centimetre (the choice of units being arbitrary), it is found that the numerical values of K_G and K_L are of the same order in many practical cases.

It follows therefore from equation (7) that the value of the gas phase resistance $1/K_g$ relative to the liquid phase resistance H/k_L will depend largely on the value of H, that is to say on the solubility of the gas. Thus, if the gas is highly soluble (H very small), then the resistance will be due mainly to the gas film. Similarly, if the gas is only slightly soluble (H is large) then H/K_L will be large compared with $1/K_L$ and the main resistance will be that of the liquid film. These two extreme cases are known as "gas film controlling" and "liquid film controlling" respectively. Many systems are intermediate between these two cases, that is to say both liquid and gas film resistances are important.

In the absorption of hydrocarbons from natural gas or refinery gases an absorbing liquid is chosen in which the desired constituents of the gas are readily soluble, so that it would appear that the process must be gas film controlling. However, the equipment used for bringing the gas and liquid into contact has a marked effect on the transfer mechanism. In the oil industry the bubble cap plate (described in the article on distillation) is used extensively in absorbers. This apparatus tends to minimize the gas film resistance and make the liquid film more important. Moreover, since the liquid in absorbers is usually at a temperature considerably below its boiling point its viscosity is much higher than it would be if it were being fractionated, and so the liquid film on a bubble cap plate is more important in an absorber than in a distillation column.

As stated above, liquid film resistances are difficult to determine and experimental values for different systems are meagre. This, together with the general use of bubble cap plates has led to the concept of theoretical plates or stages being used in absorption design rather than mass transfer coefficients. This concept was described in the earlier article on distillation and it will be assumed in the subsequent discussion that the reader is familiar with the idea.

Design of Absorbers

In a commercial absorber gas rich in hydrocarbons or "wet" gas enters the base of a tower which contains a number of bubble cap plates as in a distillation tower, and oil free from these hydrocarbons or "lean" oil enters the top of the tower. The absorbing oil flows downwards over the plates where it contacts the rising gas and leaves as "fat" oil. The gas rising upwards is stripped of the hydrocarbons which it is desired to recover and leaves containing as little of them as it is economical to leave in the gas, usually only 2 or 3 per cent. The gas-liquid contact is countercurrent and multistage. The problem of the chemical engineer is to provide a sufficient number of stages to effect the desired degree of recovery and to design equipment large enough to handle the required throughput of gas and liquid.

To simplify discussion of the first of these problems, consider a gas mixture containing a single soluble constituent, A. The first requirement is a knowledge of the equilibrium relationship between the partial pressure of the soluble component in the gas and its concentration in the liquid. This information is most conveniently represented by an equilibrium diagram similar to

the type used in distillation problems. One of these is shown in Fig 3. Note that in absorption the ordinates of such a diagram are different from those in distillation. Since the equilibrium line in Fig 3 is curved, Henry's Law does not hold but for many

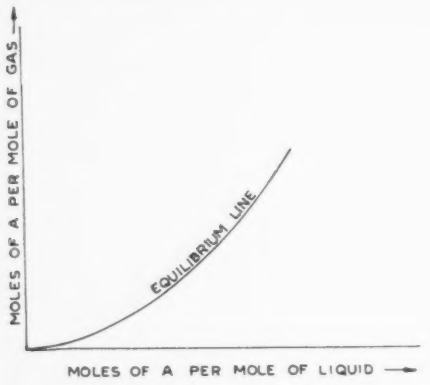

Fig 3. Typical gas absorption equilibrium diagram.

practical systems the deviations are small and little error is introduced if they are neglected. Now on a diagram such as Fig 3 we may locate points which represent conditions at the inlet and outlet of the tower. This is shown in Fig 4. The inlet gas concentration is fixed by the conditions of the problem and therefore inlet conditions will lie somewhere along the line XX^1. Inlet conditions cannot be further to the right of X^1 because point X^1 represents the highest liquid concentration that can exist in equilibrium with gas of a concentration at X, and in practice inlet conditions must be those at a point to the left of X^1 such as A, B, or C because complete equilibrium can never be reached in a finite continuous flow apparatus. Similarly if the entering liquid contains none of component A then exit conditions will lie somewhere along the line OX.

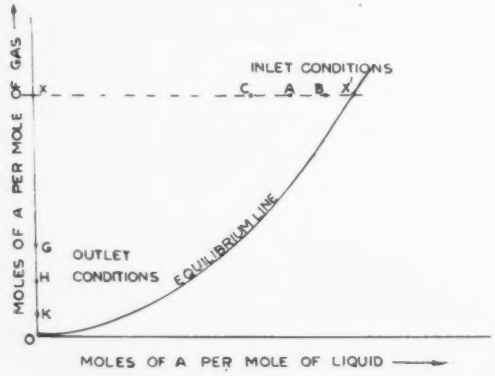

Fig 4. Location of operating conditions on equilibrium diagram.

However, once the inlet and outlet conditions are fixed a straight line (called the operating line) is drawn between them and the number of theoretical stages required to fulfil these conditions is determined by drawing steps between this operating line and the equilibrium line as shown in Fig 5.

It is clear from Fig 5 that two factors affect the number of steps required. These are the slope of the operating line and its distance from the equilibrium line. From the discussion above it follows that there is a minimum slope of the operating line which is the slope of a line joining points O and X in Fig 4. Also from Fig 5, it is seen that as the gap between the operating line and the equilibrium line widens, fewer steps are required. At the same time the final liquid concentration becomes weaker and the amount of component A that leaves the absorber becomes greater.

Now it can be shown (although it is beyond the scope of this article to do so here) that the slope of the operating line is equal to the ratio of liquid rate to gas rate. This ratio has the significance in absorption that the reflux ratio has in distillation. Since the gas rate is fixed, then the choice of this ratio fixes the liquid rate. In practice the slope is usually chosen in a suitable proportion to the minimum slope which is dictated by experience. The exit gas concentration is then decided by an economic balance between the cost of the number of stages which must be provided and the loss incurred by incomplete absorption of component A, some of which leaves in the exit gases.

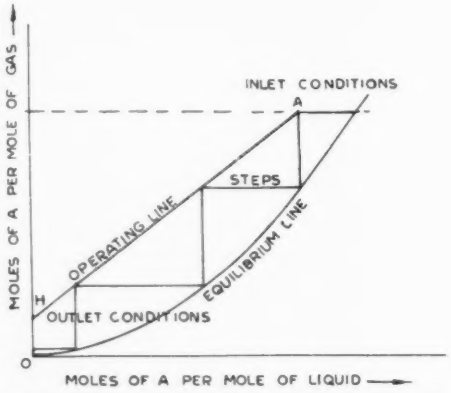

Fig 5. Determination of number of theoretical stages.

Note that this decides only the number of theoretical stages or plates. This number must be increased in practice because the efficiency of actual plates is never 100 per cent. Because diffusion is in one direction only and there is always an appreciable amount of inert gases passing through the bubble cap plates, the efficiency of the latter is considerably less in absorbers than in distillation columns. Rarely does it exceed 25 per cent and it may be as low as 5 per cent. However, since bubble cap plates give stable operation over a wide range of throughputs, and can be designed with a fair degree of accuracy they are still the most widely used type of absorption apparatus. Recently, however, a number of new types of gas/liquid contactors have appeared, the aim of which is to give a higher efficiency at a lower cost. It is as yet too early to say to what extent these new plates will replace bubble cap plates.

In the outline of design given above a gas mixture containing only one soluble component was considered. In practice of course, both natural and refinery gases contain a number of soluble components, i.e. they are multi-component mixtures. However, in absorption, unlike many multicomponent mixtures encountered in petroleum distillation, the exact compositions of such mixtures are generally known and hence the absorption problems can be treated on a sound theoretical basis. Graphical methods similar to the one already described may be used to determine the number of plates. The details of such methods are beyond the scope of this article but they may be found in the references given below.

Consider now the second problem in the design of absorption equipment, that of providing sufficient volume to handle the throughput of gas and liquid. It has been shown how the liquid rate is fixed in relation to the gas rate. The tower diameter is

generally fixed on the basis of the gas rate or more strictly the gas velocity, using an equation of the type $U = K \sqrt{1/\rho_g}$

where U = maximum allowable gas velocity;
ρ_g = gas density;
and K is an experimental constant (usually ranging from 1·3 to 1·8 for f.p.s. units). The value of K varies with the distance between the plates. Usually the plate spacing is not less than 12 inches and is generally 18 to 24 inches.

After the tower diameter has been fixed the plate design should be considered from the viewpoint of the resistance to flow of liquid across it. For towers designed to handle large quantities of liquid, the limitations of liquid flow may be more serious than those which ordinarily fix the vapour velocity.

Stripping

In refinery and natural gas processing absorption is invariably followed by stripping. In stripping the soluble hydrocarbons are removed from the absorbing liquid so that they can be further refined by distillation and the process may be considered as the converse of absorption. The fat oil is heated to liberate the absorbed vapour and steam is blown into the base of the bubble cap plate tower to improve the stripping efficiency. The steam passes through the oil as an inert gas, but it also heats the oil thus increasing the partial pressure of the dissolved hydrocarbons and it also produces by its bubbling action a large surface area for the disengagement of the hydrocarbons in vapour form. The steam leaves the top of the tower carrying with it most of the hydrocarbons originally dissolved in the entering fat oil, whilst the oil leaving the base of the tower, having been stripped of practically all its dissolved hydrocarbons, is returned to the absorber.

In this brief review of absorption and stripping it has been possible to deal only with a few aspects of the subject. For further reading the following are suggested:—

Sherwood, P. W., and Pigford, R. L. "Absorption and Extraction," McGraw-Hill Publishing Co., 2nd Edition, 1951.
Edmister, W.C. "Hydrocarbon Absorption and Fractionation Process Design Methods," *Petroleum Engineer*, May 1947 to February 1949.

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AN UNCOMMON LOAD

Bubble trays are usually designed to pass through small manholes for assembly on site, but in the above picture are seen six trays of 10ft 6in in diameter on their way from the Croydon Surrey, works of Metal Propellers Ltd., to the north of England.

U.S. PETROLEUM REFINERIES

On 1 January 1953 there were 343 petroleum refineries in the United States, a decrease of seven compared with the previous year, although the daily crude-oil capacity had increased by 305,776 brl. Average capacity per refinery was 22,270 brl, an increase of 1319 brl.

Details extracted from US Bureau of Mines Information Circular 7667 are given in the accompanying table, from which it will also be seen that cracking capacity increased by 6.7 per cent during 1952.

On 1 January the operating ratio of crude-oil capacity was 92.1 per cent, and of cracking capacity 98.8 per cent.

Capacities of individual refineries are listed by States and it would appear that the largest single refinery in the U.S. is that of Esso Standard Oil Co. at Baton Rouge, Louisiana. This refinery had a crude-oil capacity of 259,429 b.d. with a further 45,571 b.d. capacity under construction on 1 January 1953. Cracked-gasoline capacity was then 69,400 b.d. with 11,500 b.d. building. Although the Baytown, Texas, refinery of Humble Oil and Refining Co. had a slightly larger crude-oil capacity at 260,000 b.d., a capacity of 18,700 b.d. was shut down. Here, cracked-gasoline capacity was 52,500 b.d.

Largest refining State is Texas, with 63 refineries, a crude-oil capacity on 1 January 1953 of 2,107,100 b.d. operating, 35,437 b.d. shut-down, and 85,000 b.d. building. Cracked-gasoline capacity was 615,595 b.d. operating, 3,639 b.d. shut-down, and 75,400 b.d. building.

	January 1 1952	1953
Operating:		
Number	327	315
Crude capacity b.d.	7,161,366	7,481,701
Shut down:		
Number	23	28
Crude capacity b.d.	171,519	156,960
Total:		
Number	350	343
Crude capacity b.d.	7,332,885	7,638,661
Building:		
Number	—	4
Crude capacity, b.d.	282,680	509,721
*Cracking capacity b.d.:**		
Operating	1,968,978	2,123,813
Shut down	46,965	26,644
Total	2,015,943	2,150,457
Reformed	333,703	355,297
Thermal	†774,696	†789,558
Catalytic	907,544	1,005,602
Building	119,030	271,423

*In terms of cracked gasoline production.

†Includes some reformed and catalytic.

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TRADE LITERATURE, ETC.

The Owen Organization

The wide range of products manufactured by the Owen Organization, which comprises 36 companies, the parent organization being Rubery Owen & Co. Ltd., Darlaston, is shown in a 44-page booklet recently issued.

Silicones

"Silicones in motor winding" is the title of a new booklet issued by Midland Silicones Ltd., 19 Upper Brook Street, London, W.1. It deals with the use of silicones in the insulation of electrical motors. A booklet on the properties of "Silastomer" is also available from the same source.

Notes of the Month

Bitumen Repairs Holland's Dykes

The island of Goeree-Overflakkee, in south-west Holland, where 15 miles of the outer dyke and over 40 miles of the inner dyke was destroyed or badly damaged in the floods of early 1953, is now protected again. In the record time of five months the 15 miles of the outer dyke have been completely renewed by the use of a sand and bitumen mixture. A total of 22,000 tons of bitumen was needed for the task.

Assam Oil Search

To assist in the search for oil in North East Assam use is being made of an airborne magnetometer. For this purpose the Assam Oil Co. Ltd. have made a contract with Hunting Geophysics Ltd. and their Percival *Survey Prince* arrived in Assam a few weeks ago.

Life in 2000 A.D.

The Royal Society of Arts is offering, in connexion with its bicentenary celebrations, prizes totalling £500 for conceptions of life on this planet in the year 2000. Details and registration forms are obtainable from the Secretary, Royal Society of Arts, John Adam Street, London, W.C.2. Registration forms are returnable by 15 February and competition material must be submitted by 30 June 1954.

Australian Oil Search

Sir Norman Mighell, chairman of Consolidated Zinc Pty. Ltd., announced in Melbourne on 19 December that Frome-Broken Hill Coy. Pty. Ltd., formed in 1946 to explore for oil and gas in Australia, will increase its capital to £A1,000,000 in order to intensify that search.

Shareholders of the Company are D'Arcy Exploration Co. Ltd., The Zinc Corp. Ltd., and Vacuum Oil Co. Pty. Ltd. During the seven years since the Company was formed, extensive geological and geophysical work has been carried out over wide areas in Victoria, South Australia, Western Australia, and the Northern Territory and a vast amount of valuable geological information has been accumulated during that time.

Persian Oil

Anglo-Iranian Oil Co. Ltd. announced on 15 December in answer to enquiries, that informal talks were taking place in London between representatives of several oil companies on the problems likely to be involved if and when oil should once again flow in Persia.

"The sole purpose of these talks," the statement said, "is to explore on a tentative and hypothetical basis the problems involved if and when Persian oil should flow into its traditional Eastern Hemisphere markets."

On 30 December, the company announced that there was no truth in reports that, in the above informal talks, the setting-up of an internationally owned marketing company to sell Persian oil, or other measures in respect of the Persian oil situation, were even tentatively agreed.

British Oil for Denmark

Recently the Esso Petroleum Co. Ltd., and the Dansk Esso A/S confirmed in London the arrangement whereby during 1954 the British company will supply from Fawley refinery during 1954 approximately 700,000 tons of petroleum products. Value of this transaction is given as some £7½ million.

Particle Size Analysis

During the period 6-9 April the Institute of Physics is holding a conference in Nottingham on The Physics of Particle Size Analysis. The sessions will discuss (a) the motion of particles in fluids; (b) the scattering of light by particles; (c) the general phenomena encountered in particle size analysis; and (d) the comparison of methods and the automatized methods of particle counting and size. Full details can be obtained from the Institute of Physics, 47 Belgrave Square, London, S.W.1.

Institute of General Managers

Recently formed, with headquarters in London, is the Institute of General Managers, membership of which is limited to those who hold a bona fide general management appointment at the time of application. A basic concern of the new Institute is the education and training of potential general managers and branches are to be established throughout the British Commonwealth. Details can be obtained from the Registrar, Institute of General Managers, 86 Eccleston Square, London, S.W.1.

City and Guilds Insignia

About a year ago the City and Guilds of London Institute announced its Insignia Award in Technology to provide a high qualification for those who had advanced in their industry by means of progressive experience and further study.

Since that time considerable contact has been established with professional and industrial bodies and with individuals, reports the Institute, and the aid of experts has been obtained in the rôle of external assessors and on interviewing panels. Candidates' theses are now being considered and the first list of Awards will be issued in due course. A scheme is also under consideration whereby a précis of successful theses may be made available or, in exceptional cases, full publication ensured.

The Regulations governing the award are obtainable from the Director, Department of Technology (I.A.), City and Guilds of London Institute, 31 Brechin Place, London, S.W.7.

NEW AIOC TANKERS

(Left) *The* 16,000-*ton* British Guardian *on trials off the Isle of Arran prior to joining the British Tanker Co's fleet and*

(below) *the* 32,000-*ton* British Engineer *after her launching by Mrs Anthony Eden. She is the third of thirteen similar vessels.* (AIOC photographs.)

The Segas Gas-from-oil Process

Mr. Geoffrey Lloyd (centre) *has the operation of the plant explained to him, while Col Sir Harold Smith looked on.*

The Segas process for the manufacture of gas from fuel oil was recently shown to the Press at the Bell Green gas works of the South Eastern Gas Board when the plant was inspected by Mr. Geoffrey Lloyd, Minister of Fuel and Power, and Colonel Sir Harold Smith, chairman of the Gas Council.

In Britain, good gas-making coals are becoming increasingly more difficult to obtain and for some years, particularly since the second world war, the gas industry has been striving to supplement its gas output by the use of fuel oil as a raw material. Recognizing the influence this could have upon future development the former South Metropolitan Gas Company commenced investigations in 1947 and found that with certain catalysts a gas similar in composition to town gas could be produced from heavy oil.

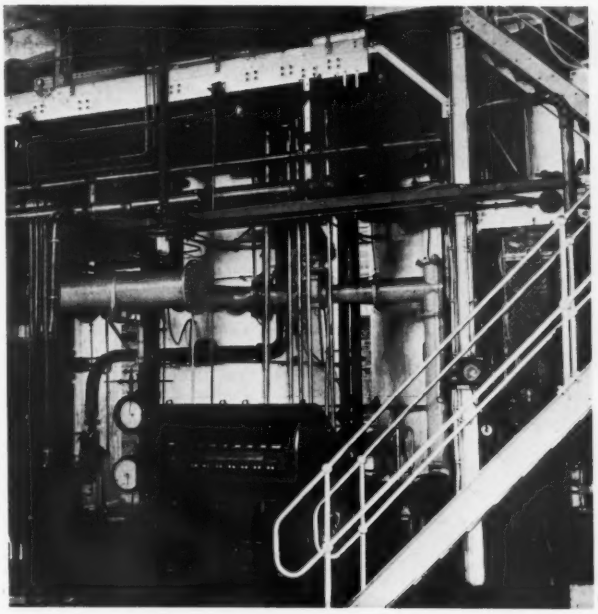
The results of this investigation were first made public at a meeting of the Institution of Gas Engineers in November 1950 when H. Stanier and J. B. McKean read a paper on the catalytic gasification of petroleum oils. It was found that the best type of catalyst was a lime-bauxite mixture consisting of 34 parts calcium carbonate, 3 parts bentonite, and 63 parts bauxite. Since that time, laboratory tests have shown the same catalyst to be effective in the reforming of refinery tail gases and of methane.

The experiments were carried to the pilot plant stage by the South Metropolitan Gas Company and on the formation of the South Eastern Gas Board the work was accelerated. The first large-scale unit, designed in co-operation with the Power Gas Corporation Ltd., was installed and started gas-making in February 1953.

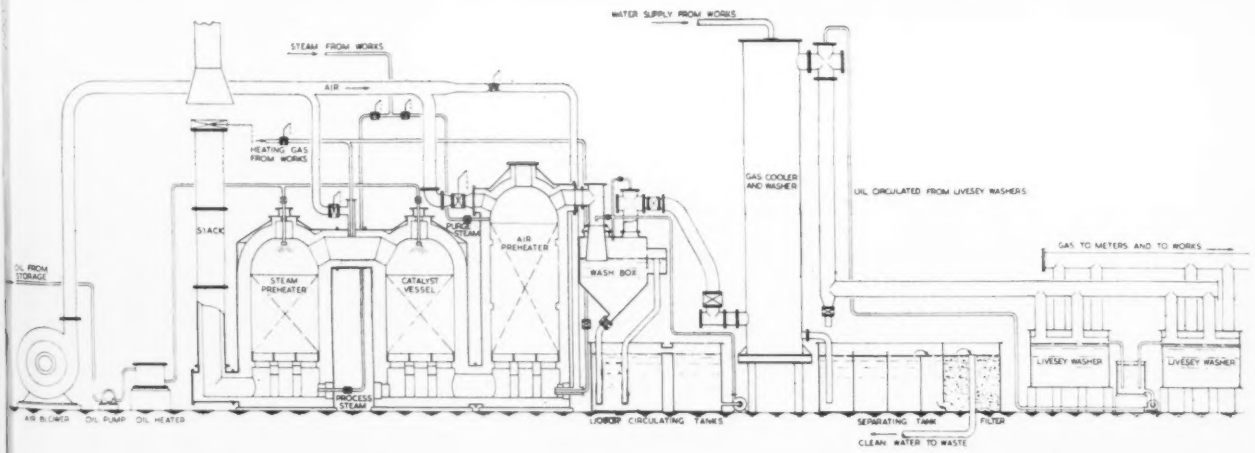
The Plant

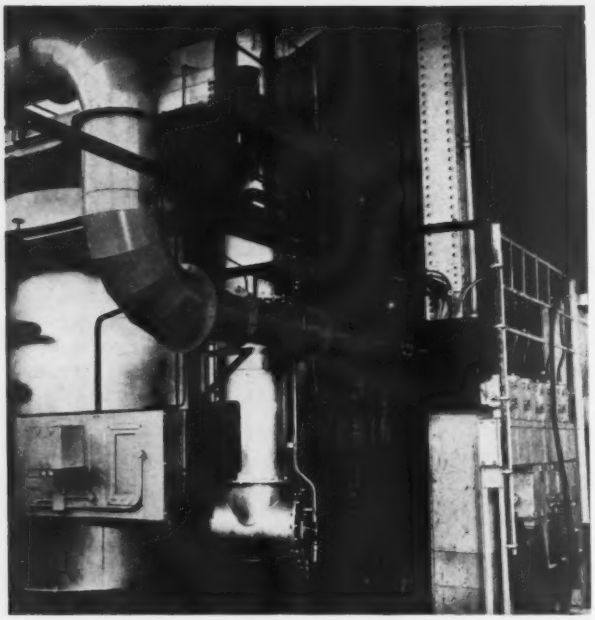
The plant at Bell Green works consists of three brick-lined steel vessels—a steam preheater and a catalyst vessel each of 8ft 6in diameter and 16ft 6in high, and an air preheater of 7ft 9in diameter and 21ft 6in high.

In operation, steam enters the steam preheater and is raised to a high temperature by passage over heated brickwork. It then meets a spray of oil and the oil-steam mixture passes to the catalyst vessel where the desired reaction occurs. The hot gases from the reactor then go into the third vessel, heating the brickwork and becoming cooled in the process. Flow continues for a short period during which temperatures in the steam preheater and catalyst bed are falling. Steam and oil are then shut off,



The heart of the Segas plant (centre foreground above) *is the mechanical operator which controls the valve changes in correct sequence, while the diagram below shows the arrangement of the plant at Bell Green.*





Reaction vessels in the Segas plant. Left to right, *steam preheater, catalyst vessel, air preheater.*

the gas offtake valve closed, and air is blown backwards through the plant, being preheated in the third vessel and burning off carbon on the catalyst and on the brickwork in the second and first vessels. The complete cycle takes about six minutes and is controlled by an automatic operator which opens and closes valves in the correct sequence.

Average consumption of the present plant is 130 gallons of 900 sec Redwood I fuel oil per hour, 2600lb steam per hour, and 9500lb air per hour, and the calorific value of the gas averages 483 B.T.U/cu.ft. During the period 24 February to 2 December 1953, the plant at Bell Green works processed 199,968 gallons of oil, from which 54 million cu.ft. of gas, averaging 1.22 therms per gallon of oil, was obtained.

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Random Recollections

By **JAS. S. PARKER (Fellow)**

The butcher, the baker, the candlestick maker all have a car. Mainly on the never-never. Second-hand car sales have outrun the demand. Hundreds line the roads into most big cities. Some dealers advertise "No down payment. Just take it away."

Drive-in cinemas and drive-in banks have been established for some years. Motels have spread throughout the land and have even appeared on this side. The latest trend, especially in development areas, is the shopping centre with its own car park where through shop concentration the housewife can obtain anything she is likely to require.

Automatic gear change. Press button windows, passenger and driver controlled. Press button radio mast. Press button seat adjustment. Air conditioning. An electric-eye dipping lights. Power steering; finger-tip control when you go through the hedge. Power braking; heavy footed and you go through the windscreen. Not long now till the advent of the iron man. Then the car driver can have a rest.

In the U.K. buses, char-à-bancs, trucks, big cars, little cars, Rolls-Royces, down to animated junk. In the U.S. big cars all to a more or less standard mould. Cars! Cars! Cars! Somehow one's thoughts drift to the Sorcerer's Apprentice.

Cars! Cars! Cars! They form a dominant recollection of any visit to the U.S.A. and Canada. Not so much their size, their bumpers, their assorted gadgets, and these are impressive enough, but their numbers.

An industrial centre is being developed on the outskirts of Toronto, well out in the blue, and it was interesting to note that a number of British firms are participating in this venture. The first procedure in the development of these new factories appeared to be the bull-dozing of an enormous car park. The explanation was simple. No car park, no labour. The interconnected problems of housing and bus transport on this side of the Atlantic become simplified on the other side to one of a car park. Housing distance from the car park does not appear to be a material objection.

These industrial estates are a partial solution to car traffic difficulties. Even so Toronto has a large-sized headache as their 100 per cent car increase, estimated for several years ahead, has already overtaken them with no apparent diminution in the rate increase.

New York is in a similar position. Near Flushing, on Long Island, outside a station on the electric train service into New York, there is a car park. And there are probably other car parks of similar dimensions at other stations on the outskirts of New York. No one takes a car into New York if they can help it. Final progress is by electric train. One tends to scoff at the American idea of size but this particular car park at any rate has to be seen to be believed. Rows and rows of cars hundreds of them, spread across the landscape. Jockeying into position in the morning and finding one's car in the evening cannot be one of the amenities of New York business life.

Even with these outlets New York remains chock-a-block full of cars, solid at all times on each side of every road. Parking charges, on the remote chance that parking is available, are high. "No parking" signs are valueless. Police tickets for infringements do not appear to be a solution. On T.V. there was advice that hundreds of tickets were outstanding and would those concerned please pay the imposed fine.

Universal Oil Products Company have moved out from Chicago into the blue at Des Plaines on the outskirts. There is a large car park. And there is sufficient land to accommodate the Riverside laboratories and make a compact assembly of laboratories and offices. This illustrates the present-day trend in the U.S.A. and Canada to pull out of the cities and develop in the more or less wide open spaces.

Chicago with its Michigan Boulevard is one of the most impressive car traffic sights in the U.S.A. This six lane boulevard has two automatic kerbs, one up in the morning to give four in and two out, the other up in the evening to give two in and four out. To the stranger, no matter the time, even midnight, there appears to be little slackening in the high traffic volume. One evening when a Chicago ship bridge was raised, a quarter of an hour sufficed for four traffic lanes to become car solid as far as one could see.

All cars maintain a comparatively high average speed. The dawdlers, so prevalent on this side, are conspicuous by their absence. Trucks, no matter their size, and they average considerably larger than on this side, bat along at the same high speed. No truck is limited to 20 m.p.h. The high car density gives the impression that trucks are few and far between. In the U.S.A. roads appear to be full of cars. On return to the U.K. roads appear to be full of trucks.

This uniform high speed has, at times, peculiar results. There was a mist one morning on the New Jersey turnpike. One car stopped and there was a seven-car pile up. Chicken feed! Twenty-three is the record.

Personal Notes

Congratulations to **W. F. C. Mackie,** B.Sc., F.Inst.Pet., manager of Shell's Cardon refinery, Venezuela, who, as British Vice-Consul at El Cardon, was appointed a C.B.E. by Her Majesty the Queen at the New Year.

T. J. Peake, B.Sc., F.I.M., M.Inst.Pet., has recently been transferred from Aluminium Laboratories Ltd. to the associate company Northern Aluminium Co. Ltd.

D. H. Leonard and **F. A. Jackman,** B.Sc., A.R.I.C., were appointed to the Board of Carless, Capel & Leonard Ltd. as from 1 January 1954. The former is a son of the chairman of the company and the latter has nearly 26 years service with the company.

A. E. Cooke, B.Sc., M.Inst.Pet., has recently joined The British American Oil Company Ltd. of Toronto, Ontario, as marketing engineer. For 18 years he was with Trinidad Leaseholds and latterly was chief engineer to Trinidad Leaseholds (Canada) Ltd.

R. G. Barker, M.C., A.M.Inst.Pet., has been appointed a director of Rekrabol Oil Co. Ltd., the company having been formed to take over the business of William Barker Junr. & Co. Ltd. which was formed in 1856.

Frank W. Abrams, chairman of Standard Oil Co. (New Jersey) retired on 1 January. He joined the company in 1912 as a draughtsman, was superintendent of a refinery after five years, manager of two refineries ten years later, and in 1927 was elected to the Board of the then Standard Oil Co. of New Jersey (now Esso Standard Oil Co.). He became its president in 1933. In Standard Oil Co. (New Jersey) he was a director in 1940, vice-president in 1944, member of Executive Committee in 1945, and chairman in 1946.

Successor to Mr Abrams is **Eugene Holman,** president since 1944 and chairman of the Executive Committee since 1946. He joined the group in 1919 as a geologist. He will be succeeded as president by M. J. Rathbone, who also becomes vice-chairman of the Executive Committee. Other changes announced are: **Chester F. Smith,** a vice-president and director, is elected to the Executive Committee; **Lloyd W. Elliott,** a director, appointed a vice-president in succession to **Orville Harden,** who retires after 43 years with the company; **Frank W. Pierce,** a director, retired for health reasons.

Chalmer G. Kirkbride, president and director of Houdry Process Corporation, has been elected president for 1954 of the American Institute of Chemical Engineers. Also **George Granger Brown,** Professor of Chemical Engineering and Dean of the University of Michigan, has been elected treasurer.

Dr K. Washington Gray, F.Inst.Pet., has recently retired after over 30 years service with the Anglo-Iranian, most of which has been spent overseas. He was formerly chief geologist in Papua and New Guinea and was managing director of Commonwealth Oil Refineries Ltd. at the time of his retirement. He is to continue to act as AIOC representative on the board of the Australasian Petroleum Co. and the Island Exploration Co.

R. B. Dummett, who succeeds Dr Washington Gray as managing director of Commonwealth Oil Refineries Ltd., was appointed AIOC area manager in 1948 responsible for Switzerland, Italy, Malta, and Yugoslavia. He has also been liaison officer between the Company and Shell-Mex and B.P. Ltd.

F. D. S. Richardson, who recently retired from AIOC, joined the Company in 1923 and was one of the party under Professor de Bockh which in 1924-5 made the survey which resulted in oil discoveries at Haft-Kel, Agha Jari, and Gach Saran. He was deputy chief geologist at head office when he retired.

Robert Crichton, J.P., Hon. F.H-W.C., F.Inst.Pet., is to retire from the managing directorship of Scottish Oils Ltd., at the end of March and will then have completed more than 57 years in the Scottish shale industry.

James Peutherer, manager of the Broxburn and Niddry Castle works of Scottish Oils Ltd., has recently retired after 55 years service. In 1918 he became manager at Dalmeny, in 1927 at Hopetoun, and in 1939 returned to Niddry Castle where he had been foreman in 1909. He was also in charge of the Broxburn acid works, the candle factory, and the wagon repair shop.

Oil Company Orders in the U.K.

The Oil Companies Materials Secretariat furnish the following statement showing value of orders for materials and equipment placed in the United Kingdom by oil companies during July to September 1953.

	£
Geophysical and other exploratory equipment, etc.	4,900
Specialized equipment for oil drilling and production, including oil casing, tubing, etc.	2,158,600
Specialized equipment for oil refineries, etc. (not including pumps and valves)	483,800
Drum and can-making, filling and cleaning equipment, kerbside pumps, other oil metering and dispensing equipment, etc.	180,700
Railcars, road tankers, aircraft refuellers, etc.	60,500
Drums, drumsheets, and tinplate	1,324,000
Tankage (including tank fittings)	1,335,800
Tubulars, pipe fittings, valves (ferrous and non-ferrous)	1,627,000
Pumps (excluding slush, oilwell, and kerbside)	193,300
Boilers, boiler house plant, accessories, etc.	55,400
Electrical equipment—motors, generators, transformers, etc.	1,072,600
Instruments, meters, gauges, etc.	185,900
Prime movers and compressors	492,200
Machine and hand tools, welding and miscellaneous machinery, and stores	1,138,300
Ferrous and non-ferrous plates, sections, sheets, and bars	445,000
Automotive equipment, all types	1,010,100
Laboratory equipment and chemicals, including hospital and medical supplies	95,200
Bulk chemicals, catalysts, barytes, etc.	1,626,800
Cement and other building materials and hardware, including timber	589,800
Commissary, general requisites for office, warehouse, household, club, sports, etc.	845,400
	£14,925,300

Recent Technical Meetings

Stores Administration

At the IP meeting on 9 December, R. C. H. Toye, manager of the Stores Department of The Shell Petroleum Co. Ltd., chairman of the Oil Companies Materials Secretariat and of the BSI Petroleum Equipment Industry Committee, addressed a well-attended meeting of the IP at 26 Portland Place. The chair was taken by H. Hyams, a Vice-President.

Mr Toye discussed the principal phases of materials administration in various branches of the petroleum industry. He devoted considerable attention to the subject of staff and emphasized that materials men must be trained and that training should start some years before they were needed. He dealt with forms of administration, with handling and storage facilities, with replenishment and accounts, and other matters pertaining to his subject.

The discussion was opened by L. S. Davis, stores superintendent at Esso Petroleum Co. Ltd., refinery at Fawley, and was lively and interesting.

Refinery Technique and Marine Fuel Oil Quality

In an informative paper read before the Institute of Marine Engineers on 8 December 1953, C. W. G. Martin (head of Quality Division, Fuel and Light Oils Dept., The Shell Petroleum Co. Ltd.) set out to convince a large but somewhat sceptical audience that modern manufacturing methods favoured the production of high quality fuel oils. A vigorous discussion followed, and while some of the engineers present remained unconvinced as to the superior quality of present-day marine fuel oils, Mr Martin undoubtedly scored some good points and there was whole-hearted support for the final vote of thanks which closed a highly successful meeting.

Dealing first with the changes which have taken place in refinery processes during the past forty years, the author referred to the effect on fuel oils of the introduction of thermal and catalytic cracking, the main object of which was to produce more gasoline from each barrel of crude oil. The fact that this gasoline was also of improved quality helped to give rise to popular misconceptions as to the quality of the residual oils produced in refineries operating crackers.

Mr Martin suggested that cracked fuels had the distinct disadvantage of a nomenclature which invited suspicion. It had even been stated on one occasion that the use of cracked diesel oils resulted in cracked pistons. It was not surprising, therefore, that cracked fuel oils, which according to popular fancy represented "the bottom of the barrel," might be regarded as being undesirable. The author's account of the catalytic cracking process effectively disposed of this "bottom of the barrel" misconception, and with regard to the tendency in some quarters to associate cracked fuels with instability, he maintained that the cycle oil, which was blended with the straight-run residue obtained during the preparation of the cracker feedstock, was an excellent stabilizer for asphaltenes present in the heavy residue. In fact, by using this cycle oil the risk of producing an unstable fuel oil was practically negligible.

To the question of what constitutes "quality" in fuel oil, there was, as yet, no simple answer. In a consideration of fuel oil specifications and conventional tests used to establish "quality", the author pointed out the value, and limitations, of tests for viscosity, flash point, and water and sediment, which are the factors covered in the normal specification for "Bunker C Grade". These tests alone were not considered sufficient by some buyers, who asked for additional test data which they hoped might elucidate why some fuels appeared to be more satisfactory than others. Typical of such tests were the Conradson carbon and asphaltene determinations, considered by some users as bearing a relationship to the combustion characteristics of a fuel oil as represented by its tendencies to produce stack solids. Experimental evidence presented by the author showed, however, that there was no correlation between the asphaltene contents of five fuel oils, covering a wide range of properties, and the amounts of solids produced during combustion.

The author's reference to the effects of the ash-forming constituents of fuel oil led to considerable discussion on external deposits on boiler heating surfaces. Still more provocative was the intentional omission of references to the sulphur content of fuel oils, a subject which, Mr Martin said, had been fully dealt with elsewhere. This did not deter the meeting from a lively discussion on the increasing sulphur content of fuel oils and its effect on boiler efficiency, dewpoint of flue gases, air preheater corrosion, etc. It was, however, accepted that there was no economical method of removing sulphur from heavy oils.

An important section of the paper dealt with fuel oil additives, for which so many and varied claims have been made, and a practical study of one such additive was described. This included full-scale trials on a ship, to demonstrate whether the particular additive had any effect upon sludge and combustion generally. The results of the trials were inconclusive, which was perhaps not surprising in view of the careful manner in which they were conducted. In the first place, any possible effect of the additive in removing and preventing further formation of sludge could not be demonstrated since the fuel oil (presumably blended according to the supplier's best "know-how") did not give rise to sludge troubles. Furthermore, the combustion side was so well controlled, even to the extent of carrying an extra second engineer whose sole duty was the conduct of the trials, that conditions were so good in the absence of the additive that no improvement could reasonably have been expected when it was used. Some speakers quoted experiences demonstrating the beneficial effects of additives, but in general it was agreed that in view of the wide variations in fuel oils it would be extremely difficult to find an additive which would be universally applicable.

In concluding this most interesting paper the author expressed the view that modern oil-burning practice was more demanding than previously, much more being expected from the fuel oils of today. In order to meet such demands, he claimed that modern refinery techniques have made possible the production of fuel oils of a quality superior to those formerly available, while more scientific methods of product control have ensured the maintenance of a high standard.

* * *

THE VOICE OF THE PAST

Feudalism in Petroleum

One of the latest companies to be formed is that known as the Saghalin and Armour Petroleum and Mining Syndicate.

...The Wells are worked by convicts, no other labour being obtainable.

It may be asked what better labour could be obtainable? It is cheap and, under Russian regime, no doubt effective.

Petroleum Review (now *Petroleum Times*), 1899.

The Crystal Ball

We intend continuing persevering on the lines we have commenced to run on, namely of making ample reserves. As a matter of fact the whole fund that we have put away as a reserve is 5 per cent on the total capital of the company, or very nearly that. The amount is £80,000.

(The Chairman, at the first Annual General Meeting of the Shell Transport and Trading Co. Ltd., 1899).

The Constructional, Operational, and Safety Features of the Modern Ocean Tanker

By **Captain J. H. DREW, O.B.E.** (*Associate Member*)

The basic principle of modern tanker design was initiated about 1886 when the bulk oil carrier S.S. *Gluckauf* was built in a British shipyard. The *Gluckauf's* oil cargo was carried in compartments or tanks, extending to the shell plating of the vessel, as is the practice in modern tanker design. Prior to this, marine transportation of petroleum products was made in barrels or in cases stowed in specially constructed steel compartments within the transporting vessel. Many of the earlier craft engaged in the case oil trade were sailing vessels. The transportation of petroleum products in separate compartments was uneconomical due to wastage of cargo stowage space, and hazardous, due to the risk of accumulation of explosive vapours in the spaces adjacent to the stowage compartments, especially if the containers developed leakages under tropical climatic conditions.

Up to 1925, separate cylindrical cargo stowage compartments were installed in certain tankers for better segregation of petroleum products having a high market value, *e.g.* lubricating oils, for the specific purpose of avoiding admixture of the various grades carried. However, few such vessels remain in operation, and modern bulk oil carrying tankers incorporate the shell of the vessel as an integral part of the cargo carrying compartment. Certain classes of small bulk oil-carrying vessels employed in U.K. river and/or estuarial waters, where local byelaws require the cargo-carrying compartments to be separated from the shell of the vessel for safety reasons, *e.g.* in the event of collision with other craft, still use the segregated or portable tank system of design incorporating an approved vent system.

Evolution

The evolution of modern tanker design can be broadly defined in three stages, *i.e.* from 1886 to 1918, 1918 to 1936, and 1939 to 1952. Improvements in design, speed, and operational performance of ocean tankers was effected between 1918 and 1936, when the average tanker about this period was of 10,000 to 13,000 dw tons carrying capacity (inclusive of bunkers, water, stores, etc.), operating at 10 knots loaded speed and propelled with triple expansion steam-driven or diesel power units. These vessels were of riveted construction, incorporating a continuous centre line bulkhead throughout the bulk oil cargo compartments as a precaution against "free surface" movement of the cargo, and incorporating small auxiliary cargo compartments or "summer tanks" located immediately below the main or weather deck, for use when carrying "light gravity" petroleum products during the seasonal periods when International Load Line Regulations permitted deeper loading of the vessel. Another major purpose of the summer tanks was to reduce further the free surface effect of the liquid in the main tanks. The summer tanks were constructed at the sides and the main tanks were filled up into the trunk formed between the summer tanks and the centre line bulkhead. Ocean tankers constructed about 1936 were mainly of increased deadweight carrying capacity of between 13,000 and 18,000 tons and of diesel propulsion of 11 to 12 knots loaded speed. This period also saw the changeover in new construction from the summer tank type of ship with centre line bulkhead to the type of tanker having two longitudinal oil-tight bulkheads and no summer tanks.

The greatly increased demands for petroleum products necessary to support military operations in Western Europe and the South Pacific during the second world war, in the face of enemy action against shipping, necessitated the rapid construction of high speed tankers to offset maritime losses, and to cope with the increased consumption of petroleum products. About 1943 the United States Maritime Commission designed and implemented the construction of "T-2 type" tankers, having a dw carrying capacity of 16,500 tons, using turbo-electric propulsion from two high-pressure water tube boilers, and of 15 knots loaded speed. These vessels were of welded construction following prefabrication of hull and superstructure sections, constructed at locations away from the waterside assembly points. They incorporated the use of twin longitudinal bulkheads throughout the length of the cargo compartments. Transverse bulkheads between each cargo compartment segregated each of eight cargo compartments into three sections, and the forward tank into two sections, *i.e.* nine cargo tanks having 26 separate cargo compartments in all, in cellular formation. The use of high-speed cargo pumps, having a maximum discharging capacity aggregating 10,000 brl/hr (1200 tons per hour) enabled these vessels to discharge a full cargo of 15,500 tons in approximately 13 hours, thereby reducing the port turnaround time and increasing transportation efficiency.

Prior to implementation of oil refinery expansion projects in Western Europe and the U.K. after the second world war, refined petroleum products were transported in ocean tankers from refineries located in close proximity to the crude oil producing fields, *e.g.* Persia, the West Indies, the U.S.A., and so on. Tankers' cargo-carrying capacity and the need for segregation of cargoes consisting of three or more grades of petroleum products were inter-related with the storage capacity and marketing offtake at the many storage terminals located in Western Europe, the U.K., etc; thus tankers constructed before 1945 served the petroleum industry satisfactorily. Since 1945 development of crude oil production in the Middle East, *e.g.* Iraq, Saudi Arabia, Kuwait, etc., associated with the construction of new refineries in the vicinity of European markets, and expansion of existing refineries in the European area, required that the raw material for the refineries, *i.e.* crude oil, be transported in tankers of increased deadweight carrying capacity and speed, with resultant economies in crude oil transportation costs.

Economies

The following comparisons illustrate the principal economies effected in crude oil transportation costs as between T-2—16,500 dw ton and the 26,800-dw ton tanker:-

	Average Cargo Fully Laden	*Loaded Speed*	*Fuel Consumption per Nautical Mile*	*Total Crew*
T-2/16,500-dw ton Tanker	15,100 tons	14 knots	35 I.G.	44
26,800-dw ton Tanker	25,400 tons	16 knots	42 I.G.	50

The approximate dimensional characteristics of ocean tankers now in service or projected by various interests are as on p. 40.

Whilst the present tendency favours tankers of 16,500 to 44,000 dw tons for the crude oil import trade, general utility tankers of approximately 12,000 to 16,000 dw tons carrying capacity are required for general service, transporting refined petroleum products *ex* the refineries to the bulk oil storage terminals located in close proximity to the marketing and inland distribution areas. A considerable amount of welded construction is incorporated in modern tankers, thereby increasing the deadweight carrying capacity of these vessels, with the additional

advantages of preventing leakages of cargo as is often the case with riveted hulls.

Tanker (dw tons)	*Overall Length*	*Beam (Moulded)*	*Mean Summer Salt Water Draft*	*Displacement (Long Tons) Loaded*
	ft inch	ft inch	ft inch	
10,000 .	470 0	61 0	26 4	15,250
12,000 .	483 0	59 0	27 7	16,800
16,500 (T-2)	523 6	68 0	30 2	21,800
18,000 .	542 0	70 0	30 5¼	25,210
21,500 .	560 0	75 0	31 1½	—
26,800 .	628 0	82 6	31 11¼	34,640
28,074 .	625 0	85 0	33 3⅜	—
32,000 .	665 0	86 0	35 0	42,000
39,000 .	700 0	100 0	34 0	51,000
44,000 .	757 0	97 0	36 0	56,000

The high initial and operating costs of the modern tanker requires that these vessels load and discharge cargo at maximum loading and discharge rates commensurate with safety, thereby reducing port turnaround time to the minimum, with the resultant increase in overall cargo carrying capacity. The modern 26,800-dw ton type tanker is capable of discharging cargo at average pumping rates of 16,000 to 18,000 brl/hr, *i.e.* 2100 to 2400 tons per hour (crude oil basis), utilizing centrifugal type cargo pumps.

Accommodation

Considerable thought and attention has been given to the living accommodation provided for Master, Officers, and crew ratings in modern tankers, the accommodation provided being well lighted and ventilated and cabins designed to accommodate one or two men, as compared with four men or more in the older type vessels. Recreation and/or messrooms are provided and serviced with pantries and galleys equipped with modern domestic facilities, all of which is capable of being maintained in a clean and sanitary condition under all climatic conditions. Toilet and washing facilities, incorporating running hot and cold water service, are adequate in number and suitably located in close proximity to the living spaces. All living accommodation is tastefully decorated and provided with all the usual domestic facilities provided in modern houses ashore. Hospital accommodation is also available in the modern tanker. The quality and quantity of food served to officers and crew in modern ocean tankers is excellent and menus are carefully compiled to furnish variety, having regard to local climatic conditions, under the supervision of an experienced chief steward and qualified cook.

Safety Precautions

Safety of vessel and crew is of first consideration in the modern tanker. Every effort is made to minimize the possibility of accidents. In addition to the usual radio equipment, the latest navigational aids are installed, including gyro compass, echo sounder, and radio direction finder. As a result of the commercial development of radar equipment, a large number of modern tankers are fitted with approved radar units.

While today fires or explosions occur infrequently in tankers, when they do occur they constitute a hazard to both life and property. Tankers differ from a shore-based oil installation, as an outbreak of fire must be fought and brought under control from inside the vessel.

Experienced personnel supervise all cargo loading and discharging operations in any tanker, and the safety equipment fitted in the tanker is designed to ensure the safety of all aboard during these operations.

In many tankers a system of CO_2 cylinders is installed for the purpose of impregnating engine room, boiler room, and pump-room spaces with an inert gas, thereby preventing further combustion in the event of an outbreak of fire. Cargo compartments are fitted with steam smothering lines and remote-control equipment through which steam from the boilers may be admitted into the compartments in the event of fire. Fire hoses and associated hydrants are installed in sufficient number and location to permit streams of water to be directed upon any part of the vessel's superstructure and/or accommodation spaces from the nearest hydrant.

Cargo compartment ventilating systems carry petroleum vapour to an elevated position on the tanker's masts where they are dispelled to the atmosphere through flame arresting equipment. The ingress of petroleum vapours into crews' quarters, engine, and boiler rooms, is minimized in the modern tanker by the strategic positioning of accommodation entrances and use of modern ventilating equipment.

The use of naked lights in tankers not certified "gas-free" is forbidden by owners' regulations and also local Harbour Byelaws, except under certain specified conditions. No electrical wiring is permitted in the cargo pumprooms. The pumproom is illuminated by using vapour-proof lights installed in sealed fittings, and deck floodlights are similarly equipped with vapour-proof fittings.

Many modern tankers are equipped with water fog nozzles. This equipment is found to be very effective in fighting oil fires and is most useful in that a plentiful supply of the extinguishing medium (sea water) is always available. Although CO_2 and foam systems are effective in fighting certain classes of oil fires, they are dependent on an unlimited supply of the extinguishing material being available in the vessel under variable climatic conditions. The water fog nozzle equipment reduces the temperature of the oil to below flash point temperature by absorption of heat due to evaporation of droplets in the water fog, which is generated when under pressure through the nozzle in conjunction with the tankers fire pumps. In order to maintain efficient unobstructed operation strainers are fitted, and remote control applicators are also used for directing the fog nozzle at a safe distance from the operator.

Tankers are also equipped with approved hand fire extinguishers installed in strategic positions in and about the vessel for extinguishing small fires in accommodation spaces, etc. Explosimeters are also carried for testing the volatile gas content of cargo compartments, etc. Fresh air masks and oxygen resuscitation apparatus is also carried and available for use if required in the modern tanker. All safety and lifesaving equipment is required to be regularly inspected and maintained in efficient condition and crews exercised and instructed in the practical use of the equipment.

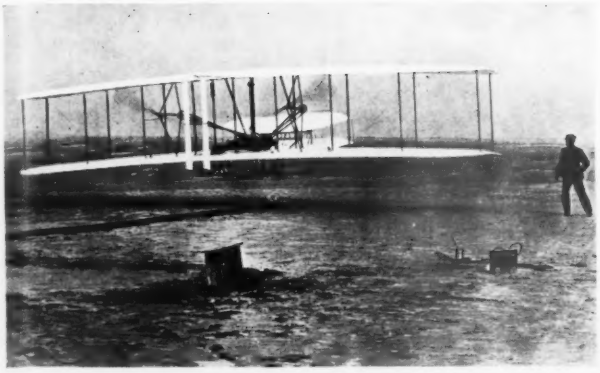
In-port Facilities

In-port turnaround time is important in the economical operation of expensive modern tankers. Marine terminal facilities for tanker discharging and loading operations at the refineries and bulk storage must be designed to eliminate unnecessary delays. This requirement may entail improvement in the loading and discharging facilities at existing terminals and increasing storage capacity thereat, thereby ensuring that refinery and bulk terminal facilities, *i.e.* pipelines, storage capacity, etc. are geared to the loading and discharging capacity of tankers likely to be in operation in the foreseeable future, having regard to the potential cargo pumping capabilities of these vessels.

Tanker personnel are required to comply with all Harbour Authorities' Byelaws and regulations made with respect to the loading, discharging, etc. of petroleum products in addition to which owners and/or oil companies' terminal safety regulations must be strictly adhered to.

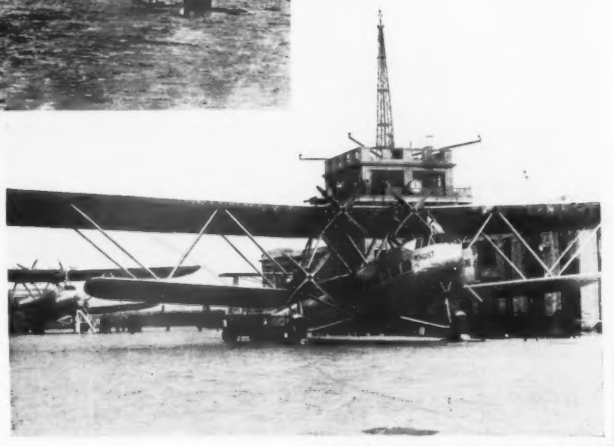
In the U.K., harbour byelaws made with respect to the handling of petroleum spirit and petroleum are made by the various harbour authorities— *vide* the requirements of the "Petroleum (Consolidation) Act, 1928" and thereafter confirmed by the Minister of Transport. Tanker personnel are also required to comply with the provisions of the "U.K. Oil in Navigable Waters Act, 1922" and also any additional regulations or agreements made for preventing the escape of oil into navigable waters, whether the vessel be in home or foreign waters.

Books and Films



Courtesy, Smithsonian Institute

(Above) *The first powered flight — the Wright Brothers machine leaving the ground at Kitty Hawk on 17 December 1903.*



Courtesy, *Flight*

British achievement in the first half century of powered flight. (Left) *The thirties saw the first British 4-engined covered cockpit air-liner, the HP 42, and in 1950 the de Havilland Comet made more flying history.*

A Shell Photograph

Powered Flight, the Story of the Century

Given its première on 17 December 1953, fifty years after the Wright Brothers first flew at Kitty Hawk in North Carolina, *Powered Flight, the Story of the Century*, is a review of the first fifty years of powered flight. Made by the Shell Film Unit with the co-operation of the Royal Aeronautical Society, the film is mainly a compilation from existing film records, some of which were found in extraordinary and amazing places. The film, in its 50 minutes showing time, records many famous flights and many famous machines, and in these days of Comets, Viscounts, and Elizabethans it is well to look back and to admire those pioneers who had the courage to take to the air in the fragile machines which were used in the early days.

The Shell Film Unit are to be congratulated on their enterprise in making this film available, as are all who have been associated with its production.

British Industries-Oil*

This survey, the first of a series, has been written to appeal to the intelligent non-technical reader and to give, within a short compass, an indication of the oil industry's activities, from the preliminary geological survey to the finished material issuing from the kerb-side pump.

The publication has been designed by W. Carter, who was responsible for the typography of the official Festival of Britain guide-books; the illustrations have been supplied by Shell, to whom the publishers also express their appreciation for assistance with the book itself.

There are ten chapters:—What oil means to man; What oil is and where it is mainly found; The hunt for oil; Drilling the well; Bringing oil up to the surface; Transporting the oil by pipelines and tankers; Refining the crude oil; Chemicals from petroleum; Distribution and marketing; Social and economic effects of the oil industry.

The style is very readable and the treatment, within the limitations imposed by the space available, gives authoritative information as to the various aspects of the industry. The criticism may however be made that the balance is not fairly struck between the production and refining sides. We have 30 pages devoted to prospecting, drilling and production, including some excellent diagrams, whereas the refining side is dismissed in one chapter of 15 pages, with no diagrams. If it is possible to give a detailed sketch of a derrick, with all the parts labelled, then the same should be done for, say, a fractionating tower. Moreover, as the book is expressly stated to be concerned with British industry, that portion of the petroleum industry which is actually located in these islands should get at least as much emphasis as the overseas operations. A very simplified flow-diagram for a typical refinery would have made the refining chapter much more intelligible to the type of reader for whom the book is intended; it need not have been more complicated than, for example, the seismic exploration diagram on p. 39.

The photographs, 45 in number, are, as might be expected from their source, excellent, and apt.

The book certainly fulfils its purpose of explaining the technology of oil at what we might call the "Home Service" level and can be recommended as preliminary reading for entrants to the non-technical side of the industry.

*Anon. London: Cassell & Co. Ltd., 1953, Pp. 120, 8/6d.

Among minor points that call for criticism is the sudden appearance of metric tons in the table on p. 24, whereas elsewhere in the book the bare term "tons" is used; whilst for the degree of accuracy required in a work of this type the difference between the ton and the metric ton is insignificant, the latter unit might be confusing to many. The U.S.A. is still composed of 48 states not 49 (p. 17); drilling mud is surely a suspension of clay, etc., not a solution (p. 45); the reference to lime, caustic soda, and bleaching earth as the reagents used in the "acid and earth" method of refining is, in the absence of any mention of sulphuric acid, somewhat misleading (p. 89). Packaging and *not* the manufacture of candles is the principal use of paraffin wax (p. 90); the inclusion of greases, special oils, paint thinners, and other materials as "by-products" of a refinery is surely extending somewhat the usual significance of that term (p. 90). The statement (p. 63) that *any* pipeline having a diameter in excess of 12 inches is called a "big-inch" is surprising.

Whilst a book of this type may not need an index (which is absent) a contents list would not have been out of place. Typography, general lay-out, and paper are first rate.

V.B.

U.K. Petroleum Statistics

Early in December 1953 the Ministry of Fuel and Power issued its Statistical Digest 1952 (HMSO, London, £1-1-0). Of particular interest is the section on petroleum with its seventeen tables relating to U.K. supplies and consumption, petroleum and shale oil refining, and overseas operations of British-Dutch companies.

Except for tables on imports and exports, which cover the period 1920-52, the information relates to varying periods such as 1942-51, 1949-52, etc., and in a number of instances includes data for 1938 as a means of comparing pre-war activities. Information is also given concerning the production of motor spirits and motor benzole from coal.

AIOC News in Pictures 1953

As a means of keeping its stockholders, employees, and others aware of its activities, the Anglo-Iranian Oil Co. Ltd. has recently issued "News in Pictures 1953." This 48-page booklet records month by month some event in Western Australia, in Kent, in London, in South Wales, in Aden, in Europe, or somewhere else in the world where the company is operating. Copies are obtainable from AIOC, General Department, Britannic House, Finsbury Circus, London, E.C.2.

Stewarts and Lloyds Ltd.

The sub-title of this 180-page book is "1903-1953", for it constitutes an illustrated commentary on major events within the organization since Stewarts and Lloyds Ltd. came into being in 1903. It presents a fascinating story of considerable interest to the petroleum industry. It tells of pipe manufacture for pipeline and refinery use, the development of "Hamel" pipe for the wartime "Pluto," of pumps and valves, and of world-wide activities.

★ ★ ★

Presented by Vacuum Oil Co. Ltd. to the British Racing Drivers' Club in November last, the John Cobb Memorial Trophy is to be awarded not more than once in any one year to a British driver of a British car who has achieved a success or successes of an outstanding character. The award will be decided by a special committee of the BRDC and a bronze medal will accompany each award.

WORLD OIL PRODUCTION

According to estimates published by *Petroleum Press Service*, world crude oil production in 1953 was 33 million metric tons, or 5.3 per cent higher than in 1952 and established a peak of 654 million metric tons. Of this, about 320 million tons were produced in the first half of the year and the balance in the second half.

Quantitatively, the Middle East had the largest rise in production—16.1 million tons or 15.2 per cent. U.S.A. production went up by 8 million (2.6 per cent) and Canada by 3 million (36.7 per cent). The only area to show a lower production was the Caribbean, where output was lower by 2.4 million tons or 2.4 per cent.

Details of estimated production by countries are given in the accompanying table reproduced by permission of *Petroleum Press Service*.

WORLD: ESTIMATED CRUDE OIL PRODUCTION

(Thousand Metric Tons)

	1948	1950	1952	1953	1953 % Increase over 1952	1953 % of World Total
North America						
U.S.A.: California	46,754	44,992	48,447	49,000		
E. of California	230,436	226,089	260,531	268,000		
	277,190	271,081	308,978	317,000	2.6	48.5
Canada	1,691	3,738	8,265	11,300	36.7	1.7
	278,881	274,819	317,243	328,300	3.5	50.2
Latin America—Caribbean Area						
Venezuela	70,116	78,240	94,626	92,000		
Colombia	3,372	4,784	5,432	5,500		
Trinidad	2,885	3,000	3,076	3,200		
	76,373	86,024	103,134	100,700	dec.2.4	15.4
Other Countries						
Mexico	8,376	10,296	10,900	10,700		
Argentine	3,330	3,492	3,570	4,100		
Peru	1,872	1,992	2,176	2,100		
Ecuador	338	337	375	400		
Chile	—	80	116	140		
Others (*a*)	93	140	177	200		
	14,009	16,337	17,314	17,640	1.9	2.7
Middle East						
Kuwait	6,400	17,291	37,637	43,000		
Saudi Arabia	19,260	26,197	40,509	41,000		
Iraq	3,427	6,480	18,843	28,200		
Qatar	—	1,632	3,297	4,200		
Egypt	1,914	2,340	2,350	2,500		
Bahrein	1,500	1,512	1,510	1,500		
Persia	25,269	32,258	1,348	1,200		
Turkey	—	17	22	25		
	57,770	87,727	105,516	121,625	15.2	18.6
Far East						
Indonesia	4,120	6,415	8,524	10,000		
Br. Borneo	2,870	4,346	5,130	5,100		
Japan	162	310	310	300		
India	249	252	258	270		
W. New Guinea	—	250	240	250		
Pakistan	58	168	179	185		
Burma	50	67	130	155		
	7,509	11,808	14,771	16,260	10.1	2.5
European Area						
Germany	635	1,110	1,755	2,200		
Netherlands	496	710	715	800		
France	52	300	350	370		
Morocco/Algeria	13	40	147	185		
Yugoslavia	37	111	152	160		
Italy	10	9	63	90		
U.K.	44	46	55	55		
	1,287	2,326	3,237	3,860	19.9	0.6
FREE WORLD	435,829	479,041	561,215	588,385	4.8	90.0
Eastern Europe and China						
U.S.S.R.	29,100	37,900	47,500	52,500		
Rumania (*b*)	4,300	5,400	8,600	9,100		
Austria	960	1,500	2,800	3,000		
Hungary	484	500	500	500		
Poland	153	178	235	250		
Albania	150	150	200	200		
Czechoslovakia	50	63	110	120		
China	80	100	120	160		
	35,277	45,791	60,065	65,830	9.5	10.0
WORLD TOTAL	471,106	524,832	621,280	654,215	5.3	100.0

(*a*) Bolivia, Brazil, Cuba; (*b*) Based on official figures.

Trinidad Oil Industry in 1952

Reporting on the petroleum industry of Trinidad during 1952*, W. N. Foster, the Petroleum Technologist, states that there was a slight increase in the overall activity.

An average of 28 drilling rigs were in operation during 1952 (27 in 1951) and footage drilled was 736,535 feet.

Twenty-five wells with objective depth of 8,000 or over feet were being drilled in 1952. Total expenditure on deep drilling was $10,566,000 in 1952, making a total of $43,814,000 since 1 January 1945.

Crude oil production at 21,257,680 brl was 2 per cent higher than in 1951, the average daily production per well was 24.1 brl Salt water production averaged 17.2 per cent of total fluid.

Refinery input was 36,044 brl and products obtained were:

	Brl
Aviation spirit:—	
100 octane	442,971
Other	1,242,463
Motor spirit	5,531,962
White spirit	440
Burning oil	876,912
Vaporizing oil	3,645,211
Gas and diesel oils	5,272,315
Fuel oil	16,584,217
Lubricating oil and grease	2,370
Bitumen	618,780
Other finished products	506,991
Liquefied petroleum gas	1,823
Feed and blending stocks	231,553

Local expenditure by the oil industry amounted to $76.6 mil, of which $51.1 mil was on account of wages, purchases, and other local expenditure. The balance of $26.5 mil represented payments to the Government and accounted for 36.4 per cent of all Government revenue of a similar nature.

*Administration Report of the Petroleum Department for the year 1952. Government Printing Office, Trinidad, B.W.I., 1953, 72 cents.

Total exports of crude oil and products were valued at $170.5 mil or 76.4 per cent of the Colony's exports of all staple products.

Petroleum bitumen exported was valued at $5 mil (2.2 per cent of total) and of asphalt $6 mil, or 2.7 per cent of all exports.

Statistical details for the five years 1948-52 have been extracted from the report and are given in Table 1.

Table 1

TRINIDAD OIL INDUSTRY 1948-52

	1952	1951	1950	1949	1948
PRODUCTION:					
			1000 brl		
Crude oil	21,258	20,843	20,632	20,617	20,107
Natural gasoline	204	201	185	168	182
			Mil. cu. ft.		
Natural gas	31,503	31,725	32,312	32,287	30,697
IMPORTS:					
			1000 brl		
Crude oil	16,722	15,855	11,214	11,333	8,840
Other process oils	274	456	21	320	20
Refined products	32	36	23	25	22
REFINING:					
Runs to stills	36,041	35,160	29,813	29,617	27,074
EXPORTS:					
Crude oil	1,844	1,918	2,194	2,037	1,796
Refined products	32,934	32,441	26,956	27,708	24,846
			$1000		
Value	175,491	161,859	129,183	99,166	96,287
DRILLING:					
			Number		
Oil wells completed	177	131	136	130	134
Wells abandoned	5	9	8	14	7
Footage drilled	736,535	664,887	659,565	630,209	638,681
WELLS:					
			Average		
Flowing	594	584	594	616	629
Artificial lift	1,813	1,696	1,603	1,473	1,384
Total producing	2,407	2,280	2,197	2,089	2,013
			Brl		
Aver. daily per well	24.1	25.1	25.7	27.0	27.3

★ ★ ★

INFRA-RED SPECTRA

The increasing use of infra-red spectra, and the expensive nature of reproduction of these spectra on an adequate scale in journals publishing original research, were placing a burden on certain publishing Societies which gave rise to considerable concern. The Royal Society, the Chemical Society, the Physical Society, the Faraday Society, the Institute of Petroleum, and the Society of Public Analysts and other Analytical Chemists, as well as other interested Bodies, appointed representatives to a Joint Committee whose Report has since been accepted by the Societies named. The Report recommended conditions which should be satisfied before infra-red spectra were reproduced in published papers and laid down the format to which it was recommended such spectra should conform. The Joint Committee is investigating the possibility of setting up some organization which shall undertake the publication of infra-red spectra, preferably in collaboration with one or other of the American organizations which exist with the same object.

As an interim measure, until a full library scheme is in operation, the Chemical Society accepts for deposit copies of infra-red spectra referred to or published in new papers in its own journals, and offers its facilities to other Societies publishing original research. It should be emphasized that deposition of spectra is voluntary on the part of the author, with the object of the spectra being generally available in a form larger than can be printed; it is not a condition of acceptance of papers for publication.

All spectra deposited with the Society must be drawn in Indian ink, with all other lettering in pencil, on forms obtainable from the General Secretary, the Chemical Society, Burlington House, Piccadilly, London, W.1, price 6s per pad of 50 sheets.

Photocopies of spectra thus deposited are made available to the public on request to the General Secretary, the Chemical Society. Applications must quote the C.S. number of the spectra desired and must be accompanied by a remittance of 3s per copy per spectrum (post-free) (special rates will be quoted for a large number ordered at one time).

Lists of spectra available are published quarterly in the *Proceedings of the Chemical Society* and annual lists will be published in the Index Volumes of the *Journal of the Chemical Society*.

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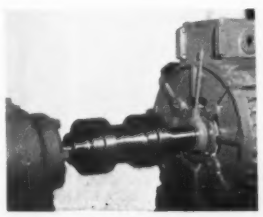


This flexible coupling for pump and compressor drives was recently shown to the Press at Fawley. Known as the Metastream, it is claimed to be specially suitable for oil refinery work. Details are obtainable from Metaducts Ltd., Catherine Wheel House, High Street, Brentford, Middlesex.

EUROPEAN FEDERATION OF PETROLEUM EQUIPMENT MANUFACTURERS

The formation was announced in Paris, on 9 December 1953, of the Federation Europeene des Constructeurs de l'Equipment Petrolier (European Federation of Petroleum Equipment Manufacturers)—"F.E.C.E.P."

Delegates from Belgium, France, Germany, Italy, the Netherlands, and the United Kingdom took part. All other member-countries of OEEC are invited to join.

Mr Douglas Wilson, chairman of the Council of British Manufacturers of Petroleum Equipment, was unanimously elected president of "F.E.C.E.P."

Mr Maurice Poignon, the authorized delegate of the French Association of Equipment Suppliers to the Petroleum Industry, was appointed Secretary of the new association, of which the temporary headquarters will be at 10 Avenue Hoche, Paris 8.

The Council of British Manufacturers of Petroleum Equipment is putting its experience at the disposal of the new body in the person of Mr Frank Kenyon, as liaison officer.

The principal aims of the new association are the following:—

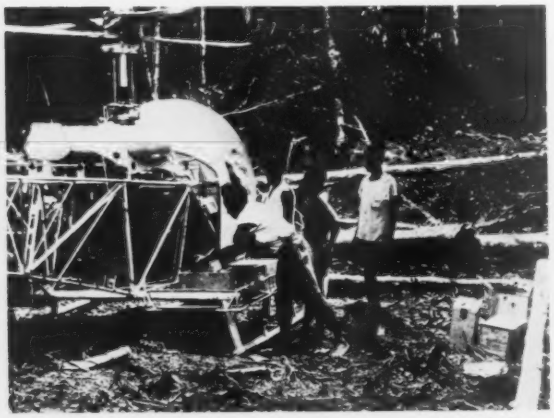
(1) Co-ordination of technical information so as to perfect the performance of a specialized European industry, which will supply the needs and contribute to the ever-intensifying nature of the development of petroleum equipment (e.g. quality of production, normalization, specifications, methods of construction).

(2) To facilitate the task of existing and future bodies in each member-country in making effective contribution to the growth of new technical developments for the petroleum industry on an all-European scale. (e.g. fundamental research, new applications).

(3) To draw the attention of the highest authorities towards those special economic problems whose international solution seems indispensable to the development of the petroleum equipment industry.

(4) To make the world market fully aware of the great possibilities and capacity of European producers.

NEW GUINEA OIL SEARCH



A Shell Photo

In large-scale exploration work being carried out on a 38,000-square mile concession in Dutch New Guinea by the Nederlandsche Nieuw-Guinee Petroleum Mij., the helicopter has proved invaluable. The transport of men and supplies had proved almost an insuperable problem but single-engined two-seater Bell 47D machines solved the difficulty. With two machines operating average load over six months was 78 tons per month. In a monthly period of 50 machine days, 974 flights aggregating 183 flying hours covered 5,600 miles. The photo shows a machine in a jungle landing-ground.

FORTHCOMING MEETINGS

THE INSTITUTE

(*At* 26 *Portland Place, London, W.*1, 5.30 *p.m.—tea* 5 *p.m.*)

Accident Prevention. T. T. MacLean. **10 February**

Oil Production in the Nottinghamshire Oilfields. C. M. Adcock, M.A., A.M.I.Chem.E., and R. K. Dickie, B.A., B.A.I., F.Inst.Pet. **22 February**

Symposium on Metal-Working Oils. At the Institution of Electrical Engineers, 2.30 p.m. **19 March**

IP FAWLEY BRANCH

(*At Esso* (*Fawley*) *Recreation Club, Holbury*, 7.30 *p.m.*)

Pumps—their Design, Manufacture, and Application. B. H. Gibbs, A.M.I.Mech.E. **19 February**

Corrosion Problems. W. E. J. Lewis. **12 March**

IP LONDON BRANCH

(*At* 26 *Portland Place, London, W.*1, 6 *p.m.—tea* 5.30 *p.m.*)

This Detergent Age. J. O. M. Alexander, B.A. Meeting followed by **Fork Supper.** **17 February**

Careers in the Petroleum Industry. E. L. K. Frost. **17 March**

IP NORTHERN BRANCH

(*At Engineers' Club, Albert Square, Manchester* 2, 6.30 *p.m.*)

Annual General Meeting and **Any Questions.** **16 February**

Natural Oils, Fats, and Waxes. **16 March**

IP SCOTTISH BRANCH

Recent Advances in the Analysis and Testing of Petroleum. W. H. Thomas, A.R.S.M., F.R.I.C., F.Inst.Pet. Scottish Oils Ltd. Recreation Hall, Grangemouth. **25 February**

Gas Turbines. J. R. Bolter. Institute of Engineers and Shipbuilders, Glasgow. **11 March**

IP SOUTH-EASTERN BRANCH

(*At King's Head Hotel, Rochester*, 7.45 *p.m.*)

Pumping in Industry. Len Ward. **2 March**

Industrial Relations in the Oil Industry. C. A. Tucker. **6 April**

IP SOUTH WALES BRANCH

(*At Training Centre, National Oil Refineries Ltd., Llandarcy*, 5.30 *p.m.*)

The Oil Industry in World Economy. M. E. Hubbard, B.A., M.I.Mech.E., F.Inst.Pet. **4 March**

IP STANLOW BRANCH

(*At Grosvenor Hotel, Chester*, 7.30 *p.m.*)

Exploration for Natural Gas in the U.K. G. M. Lees, M.C., D.F.C., Ph.D., F.G.S., F.R.S. Joint meeting with Institute of Fuel. **17 February**

Fluorine-containing Lubricants. A. J. Rudge, B.Sc., Ph.D. Joint meeting with Royal Institute of Chemistry. **4 March**

Refinery Operational Programming. A. N. Holmes, M.A., M.Inst.Pet. **17 March**

OTHER SOCIETIES

Distribution and Chromatographic Methods of Analytical Fractionation. Dr R. R. Goodall. Royal Institute of Chemistry, at Technical College, Widnes, 7.0 p.m. **18 February**

Diesel Engines in Agriculture. R. M. Ogorkiewicz, B.Sc., A.C.G.I., D.I.C. Diesel Engine Users Association, at Caxton Hall, London, 2.30 p.m. **18 February**

Design of Pressure Vessels and the Mechanism of Failure in Service. A. H. Goodger. Institution of Chemical Engineers, at the University, Edmund Street, Birmingham, 6.30 p.m. **10 March**

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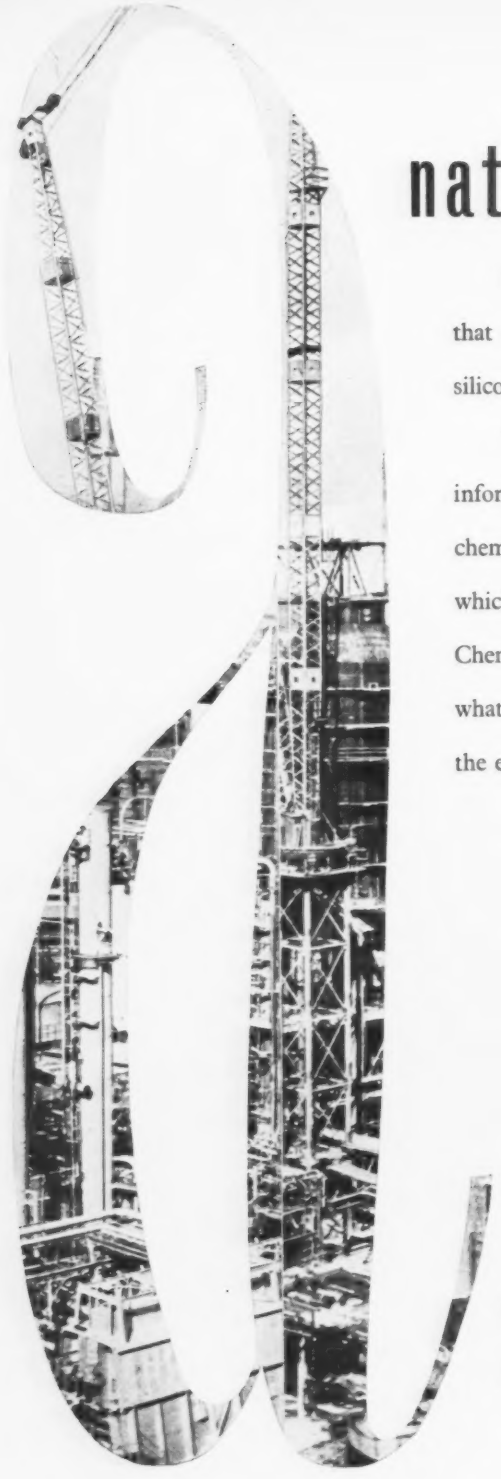

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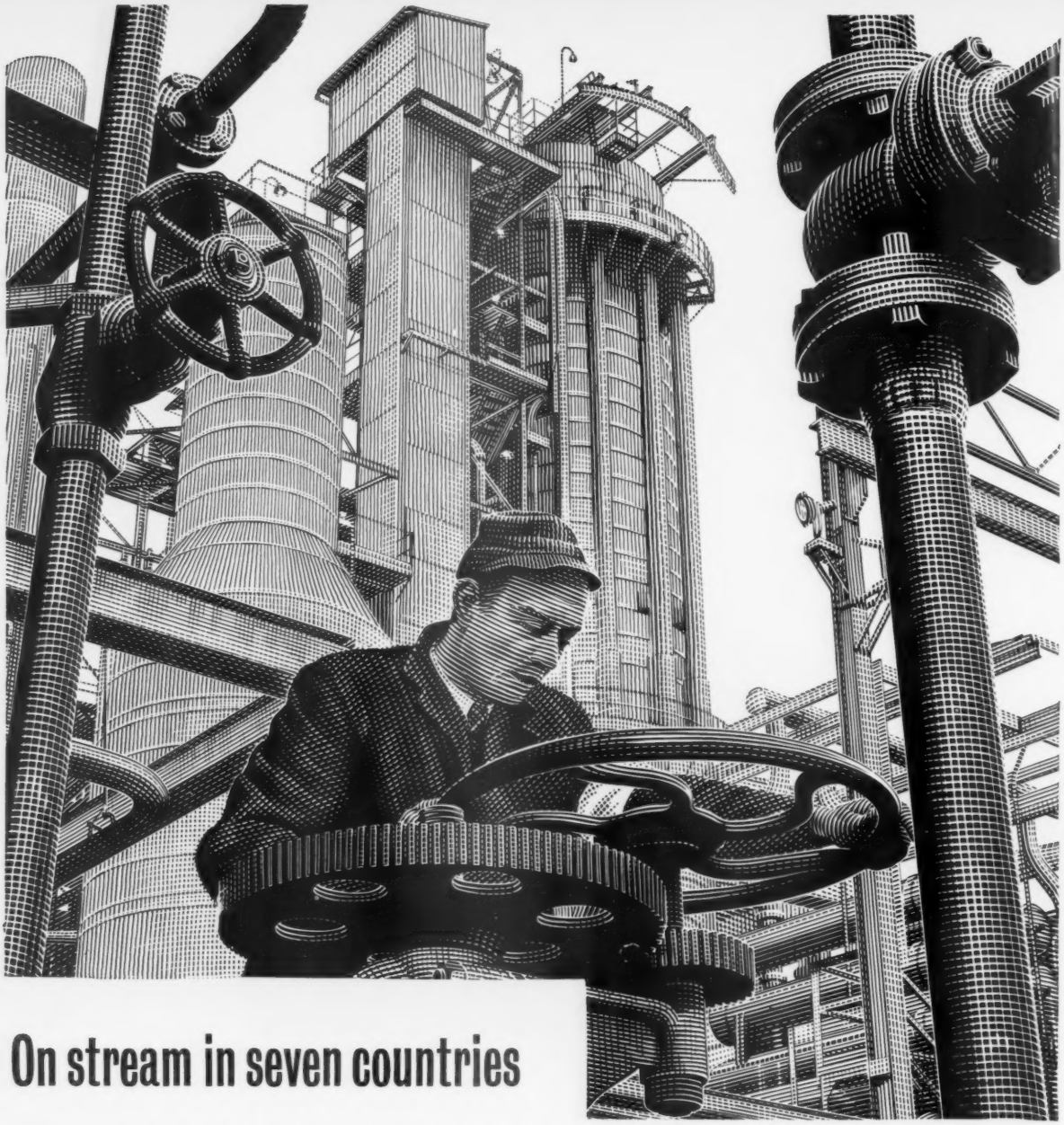

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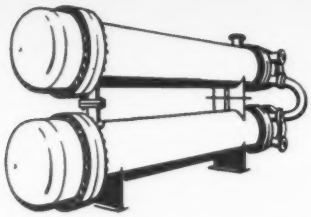

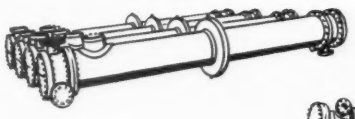

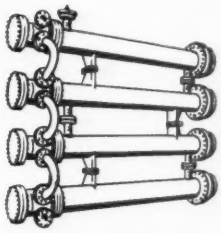

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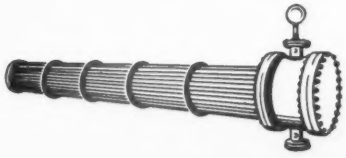

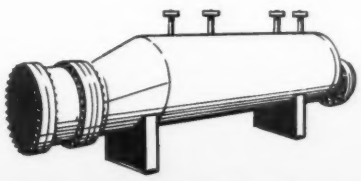

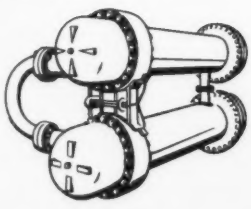

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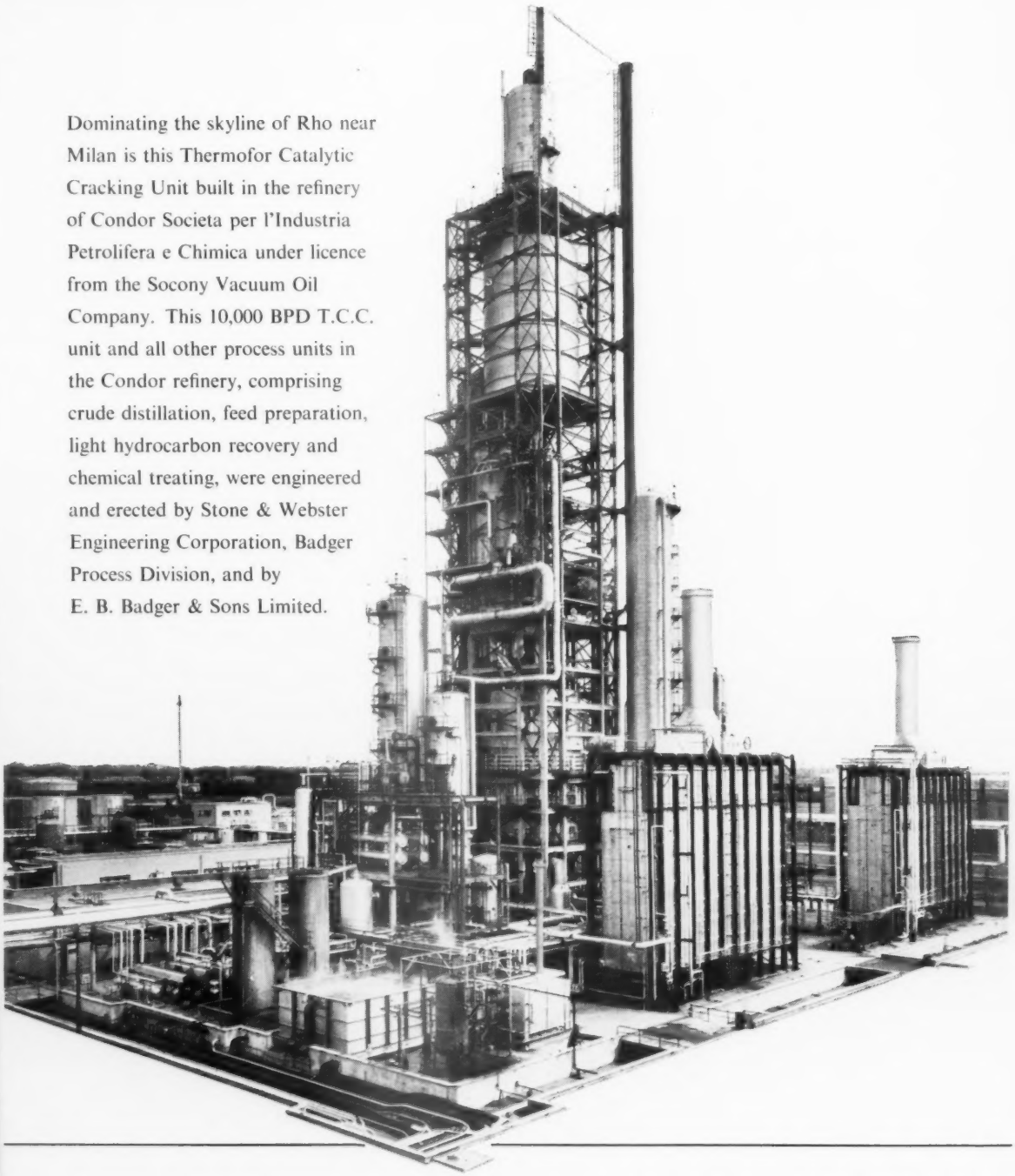

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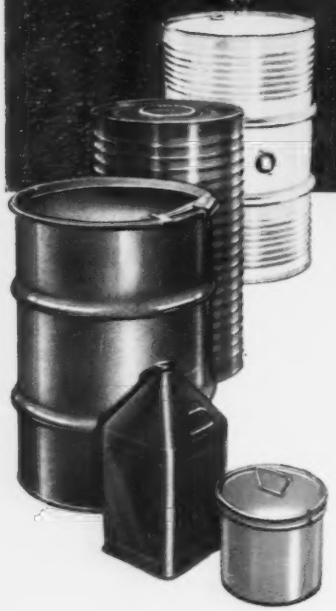

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